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November-December 1955

METAL TREATING

MTI MASTER CRAFTSMEN
METAL TREATING INSTITUTE

Subzero treatments for metals are becoming increasingly important. Temperatures down to −90°F. can be achieved by dry ice. (See page 2)

Season's

Greetings

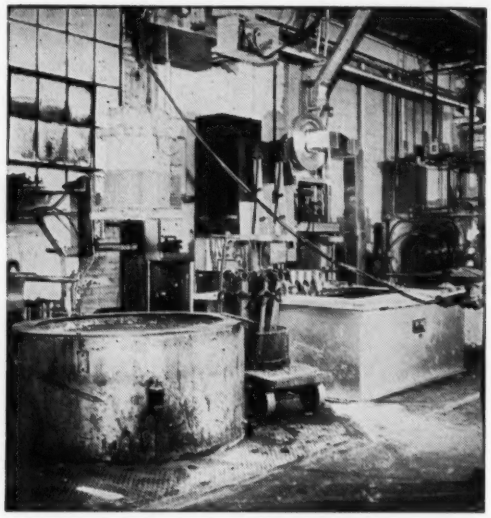
THE *Only* MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

WHY NOT LEASE?

1. Leasing adds to your working capital and profits.
2. A positive method to make extra profits in 1956.
3. A five-year lease uses, average *$5,016.00 corporate dollars,* against an $11,000.00 installation.

Holden Type 401 Marquenching Unit
FOR EXTRA PROFITS

This installation is in one of the large tractor plants where work is quenched from an electrically heated carburizing furnace and by hot salt quenching. The user is obtaining RC hardness values of from 63 to 67 with substantial improvement in gear performance. In actual field tests these gears, hot quenched, have a life expectancy of approximately 2½ times conventional oil quenching and tempering.



Holden Type 401 and View of Electric Pit Furnace

Flame Characteristics and Fire Potential with Heavy Charge Quenched in Oil

A 750-lb. charge is cooled in approximately 5 minutes with no greater temperature rise than from 5°—10°F., depending on the temperature used. In this installation, therefore, the power consumption is the power used on the motor driven pumps which use 1.11 KWH per hour for the three pumps under full load with 450-gallons per minute velocity.

This method of quenching, therefore, eliminates fire hazards from inflammable oils plus producing an improved article which has been heat treated with better gradient between case and core.

THE A. F. HOLDEN COMPANY

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METAL TREATING INSTITUTE

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Indexed in Engineering Index

EDITORIAL

SECOND ANNUAL ACHIEVEMENT AWARD

The Annual Achievement Award, established a little over a year ago by the Board of Trustees of the Metal Treating Institute, is presented each year at the Annual Meeting of the association.

In our November-December, 1954, editorial we announced the first presentation and at that time wrote:—

> ". . . it is the hope of the Institute as an association that 1955 will develop an outstanding contribution from somewhere within the metalworking industry."

On the same page, the Table of Contents listed a feature article entitled "Dimensional Control System Minimizes Finishing Costs" by L. L. McArthur and E. H. Kinne. This article was destined to be the outstanding contribution for 1955 and a few weeks ago Messrs. McArthur and Kinne were presented with the second Annual Metal Treating Institute Achievement Award. (See page 38)

The Award Committee, in reviewing the article, its illustrations and charts were unanimous in their opinion that the authors, in setting up the system described, had made a major contribution to the heat treating industry in connection with a very specific and common problem, namely the methods employed in handling, treating and quenching a product in such a manner as to permit systematized control of dimensional specifications.

If you missed this article and would like a copy, write us for a back issue. We will be glad to send you one while the supply lasts.

And, as usual, at this time of year "Season's Greetings" and the best of everything for our readers in 1956.

C. E. Herington

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SUBZERO TREATMENTS FOR METALS

By **THOMAS A. DICKINSON**
West Coast Reporter

ALTHOUGH the refrigerator may never rival the furnace as the metal treater's most important asset, subzero treatments have in the past fifteen years become a topic that no metalworker can afford to ignore. This is so not only because low temperatures do some things that high temperatures can't do, but also because extreme cold can improve product quality and reduce the cost of processes which necessitate the use of heat.

With refrigeration facilities that are now commercially available, it is possible to reduce the temperature of a metal component to within a fraction of a degree above absolute zero (or –459° F.). So far, few production processes necessitate the use of temperatures below –150° F. This is at least partly due to the fact that the equipment which is required for ultra-low temperature processing remains relatively expensive to buy and to use. However, there is reason to believe that temperatures in the neighborhood of absolute zero will soon find a number of commercial applications in spite of cost considerations.

For example, recent research at the National Bureau of Standards has shown that ultra-low temperatures can make it possible to use materials like columbium nitride in place of selenium in the construction of rectifiers for alternating current, and allows the use of tin, lead, aluminum, and zinc as "superconductors" of electricity.

With a commercial refrigeration unit of the type shown here, temperatures can be reduced from 70°F. to —85°F. in only ten minutes.

In general, cold treating processes in commercial use at present serve the following purposes:

(1) Dimensional stabilization of precision parts, gages, or master gage blocks.

(2) Improvement of the hardness and wear resistance of gears, pinions, shafts, molds, dies, pump parts, and other components comprising carburized alloy steels.

(3) Prevention of warpage and elimination of cracks due to grinding and machining operations in ball bearing races, hardened steel parts, aluminum alloys, and castings.

(4) Increase in the useful life of drills, reamers, milling cutters, taps, gear hobs, blanking dies, hacksaw blades, and related cutting tools.

(5) Improvement of the properties of materials for permanent magnets.

(6) Rapid seasoning or aging of cast iron.

(7) Retarding the age hardening of certain aluminum alloy components so that they can be formed satisfactorily many hours or days after they have been annealed.

(8) Betterment of the dimensional stability of aluminum and magnesium alloy castings, forgings, and machined parts.

(9) Elimination of the need for double tempering of some high speed steel tools.

(10) Lengthening the cutting life of "off-the-shelf" tools which may not have the exact heat treatment required to bring out their best properties.

(11) Improvement of the accuracy, stability, and freedom from warpage of machine tool components such as precision machine beds and ways or jig borer master screws.

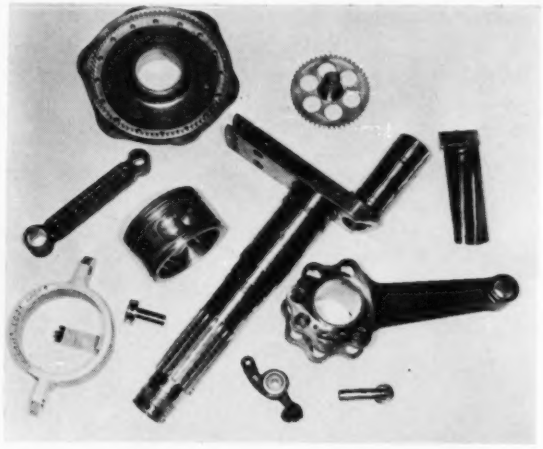
(12) Increase in the strength of welded assemblies (especially by eliminating retained austenite in welds).

(13) The salvaging of expensive out-of-size dies, once they are hardened, by altering their dimensions.

(14) Improvement of the ductility of metals for deep drawing operations.

According to a survey that was recently conducted by Bowser Technical Refrigeration Company, less than 20% of the plants that have heat treating facilities now have cold treating equipment; yet at least 50% of these firms could make effective use of subzero processes. Therefore, it is believed that a review of some of the more important heating and refrigeration techniques is in order at this point.

In the manufacture of gage blocks, for instance, it is a common practice to employ lengthy stabilizing cycles—some of which consume over 100 hours of time. The purpose of this is to eliminate retained austenite from hardened steel blocks so that all expected growth due to austenite transformation to martensite will take place before the gages are ground and lapped to permanent dimensions. Because of the time requirement, a few concerns like Precision Tool Manufacturing Company of Cicero, Ill., have found it possible to save money by means of subzero metal treatments. For example, where it has been necessary to produce 4" gage blocks comprising plain high carbon, selected quality



Cold treatments enable parts comprising carburized alloy gear steels to acquire extra hardness and wear resistance.

steel with a guaranteed accuracy of three millionths of an inch, the following cycle has been successfully used:

(1) Heat blocks to 1450° F.

(2) Water quench blocks down to 150° F.

(3) Refrigerate block to −145° F. for one hour.

(4) Transfer cold blocks to tempering furnace and heat at 165° F. for one hour.

(5) Repeat operations (3) and (4) twice.

This is said to have reduced the manufacturer's stabilizing time requirements from 96 to 8½ hours. No room temperature defrosting or cooling interval was used, since it was found to be desirable to transfer blocks to or from low and high temperature chambers as rapidly as possible.

Where elaborate refrigeration facilities are not available, metals can be cold treated at temperatures down to about −90°F. by means of dry ice.

A cycle similar to the one cited above has been used to increase hardness and helps to eliminate grinding cracks and improve the wear resistance of carburized steels. It required only one cold treatment at −125° to −150°F. for 30 minutes and one hour of tempering at 350°F.

Parts comprising carburized alloy gear steels retain considerable austenite in their case after they are hardened and tempered because the average tempering temperature will not transform any considerable amount of austenite. Consequently, the parts often lack adequate wear resistance. However, if a subzero treatment is included in the processing cycle, virtually all of the austenite is transformed and much greater case hardness is attained—providing, usually, that the parts are quenched directly from the pot or furnace.

Carburizing steels that respond best to cold treatments include SAE 4320, 3310, 8620, 2512, and 4920. Refrigeration increases their case hardness from 3 to 10 points on the Rockwell C-scale.

In steels for plastic molding dies, carbon is usually minimized in order to reduce annealed hardness where the materials are to be hobbed. A common practice at present is to add more and more alloying elements to these steels so as to increase their mechanical strength properties, but this usually has the undesirable effect of minimizing the hardness and wear resistance of finished tooling surfaces due to the large

amounts of austenite that are produced when the materials are carburized. A much better procedure is to chill the molds at –150°F. for 30 minutes prior to the tempering operation, since this restores high hardness—an important property in plastic tooling which is relatively expensive, and which must be used for long periods of time.

Cold Treatment of Steel

The lifespan of cutting tools has been increased as much as 500% by means of a variety of cold treatments, the nature of which in each case depended on the steel analysis and prior thermal history. One such

In many circumstances, parts can be transferred to or from a heat treat furnace and refrigeration chamber without intermediate cooling or defrosting.

treatment, for 18-4-1 high speed steel, is indicated in the following cycle:

(a) Preheat to 1550°F. and transfer to high heat of 2350°F.
(b) Oil quench.
(c) Refrigerate at –150°F. for 15 minutes.
(d) Temper at 1025° to 1050°F.
(e) Air cool.
(f) Refrigerate at –150°F. for 15 minutes.
(g) Temper at 600°F. for stress relief only.

Another treatment that has been successful (for high carbon, high chromium tool steels) is shown in this cycle:

(1) Harden from 1850°F.
(2) Air quench.
(3) Refrigerate at –150°F. for 15 minutes.
(4) Temper at 425°F.

Tool hardnesses produced by the last two cycles range from 65 to 67 on the Rockwell C-scale.

In the production of permanent magnets, the ability of ferrous materials to retain magnetic charges has been greatly improved by refrigeration at –150°F. for two hours and tempering at 350°F. This converts nonmagnetic austenite into magnetic martensite.

Cast iron engine blocks, heads, and related parts have been stabilized with unprecedented speed by cooling them at about 140°F. for one hour, and then heating them to about 550°F. Where freedom from age cracking or growth is especially important, this cycle is repeated before the parts are machined and ground to permanent dimensions.

If a die is accidentally made undersize, or if it shrinks during heat treatment, it may be salvaged by soaking it for one to four hours at –140°F. and then tempering it at 350°F. This causes retained austenite to become martensite, and resulting growth can bring the tool back to desired dimensions.

Refrigeration to prevent the age hardening of solution-treated aluminum alloys (such as the 17S and 24S alloys) is one of the oldest cold treatments for metals. Such materials will harden in 16 hours or less at temperatures of 32°F. or more. If chilled to –20°F., they may be stored for more than three weeks without appreciable hardening; and if chilled to –40°F., they can be stored indefinitely without aging. The effect of low temperatures in circumstances of this type is to retard what physicists call "thermal chaos," or the intra-molecular movements which are responsible for virtually all natural changes in the structures of materials.

Cold Treatment of Alloys

The dimensional stability and machinability of both cast and wrought forms of aluminum and magnesium alloys can be improved by a cold treatment which is incorporated in the following general process:

(a) Solution treat in accordance with the time and temperature recommended for the alloy.
(b) Water quench aluminum and air quench magnesium alloys.
(c) Age harden at the temperature recommended for the alloy.
(d) Air cool.
(e) Refrigerate at –140°F. for two hours.
(f) Bring the alloy back to room temperature.
(g) Heat to 25°F. above the recommended aging temperature for two or three hours.
(h) Air cool.
(i) Repeat operations f, g, and h.

The lower temperature exposure and overaging indicated by the above procedure not only improves stability, but accelerates structural changes that might take place in service. Thus, if any growth should occur, dimensional deviations in the nonferrous materials can be detected and corrected while the materials are being fabricated. Such detection is a matter of particular importance in the manufacture of aircraft. ■ ■ ■

Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Production Up 50 pct with Bearcat Riveting Tool

For some time a manufacturer had been using a tool made of alloy steel, 2½ in. round, to cold-rivet weight-lever sets, 1 7/16 in. sq, for railroad switch stands. The tool was used in a series of rotating blows, average production being 70 pieces per tool before redressing was required.

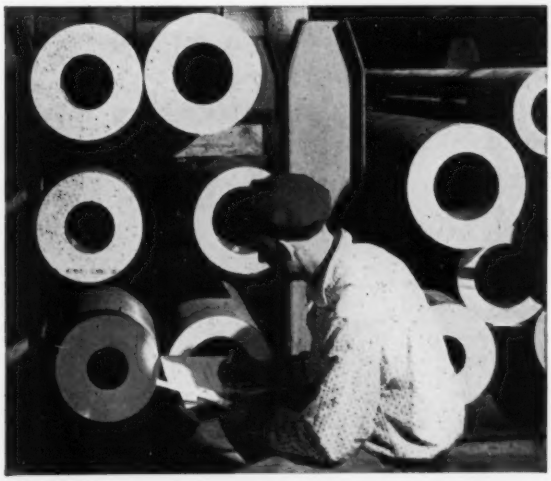
As the operation clearly called for steel with exceptional resistance to shock and wear, we suggested, "Why not give Bearcat a trial on that job? Bearcat's got the toughness you want. What's more, we wouldn't be surprised if it gave enough longer life to bring down your costs."

They made the change, with the result that tool life increased about 50 pct.

Bearcat is a tough, general-purpose grade of air-hardening tool steel. It has exceptional resistance to shock, and superior wear-resistance. Its air-hardening characteristic minimizes quenching hazards, and also provides good resistance to distortion in heat-treatment.

In addition to cold-riveting tools, there are many other applications in which Bearcat gives a good account of itself —in such tools, for example, as chisels, gripper dies, master hobs, hot headers, and die-casting die inserts.

Why not look into Bearcat? You can obtain full information from your Bethlehem tool steel distributor.



Save Time with Hollow-Bar in Ring-Type Applications

If you use draw rings, hardened bushings, ring dies or the like, you'll find you can save time in the shop with Hollow-Bar Tool Steel. Bethlehem Hollow-Bar comes in two types: BTR (oil-hardening) and Lehigh H (high-carbon, high-chrome). It's made by a high-speed trepanning process, which cores out the inside diameter of hammer-forged or hot-rolled, rough-turned bars. Hollow-Bar goes to work for you immediately. There's no waiting for forged rings or discs — nor are drilling, rough boring or facing, or rough turning required. Just think of the time that saves!

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Here's a Quick Look at Short-Run Dies

There are many types of dies used for blanking or forming where the production required may be only a few hundred pieces, or less. Such requirements occur frequently, as in the aircraft industry, for example. In such circumstances, the normal procedure of machining a die, then heat-treating and grinding it (to produce a die good for millions of parts) is neither practical nor economical. What is desired is a steel which can be machined to size, then used immediately.

One of our standard grades which is ideal for this application is Brake Die Tool Steel. Brake Die comes in rounds, squares and flats. It is a free-machining steel, and has been heat-treated at the mill to the highest hardness possible consistent with good machinability. On forming operations, dies made of Brake Die will last for tens of thousands of parts. And on blanking operations, it will produce anywhere from a few hundred parts to a few thousand, depending of course upon the type of material being blanked, and its thickness.

For further information circle No. 2

HEAT TREATING COLD FORGINGS

By **HARRY A. KIRKPATRICK,** *Manager*
Hycon Ordnance Division
Hycon Manufacturing Company
Pasadena, Calif.

BY MAKING effective use of heat treatments, Hycon Manufacturing Company of Pasadena, Calif., is now saving considerable money by cold forging fin blades for U. S. Navy rockets.

The parts in question were previously hot forged. That was relatively expensive due to the need for relatively high processing temperatures which in turn retarded production, minimized die life, and caused parts to become contaminated with tooling lubricants to such an extent that they could be cleaned only with a nitric acid etchant.

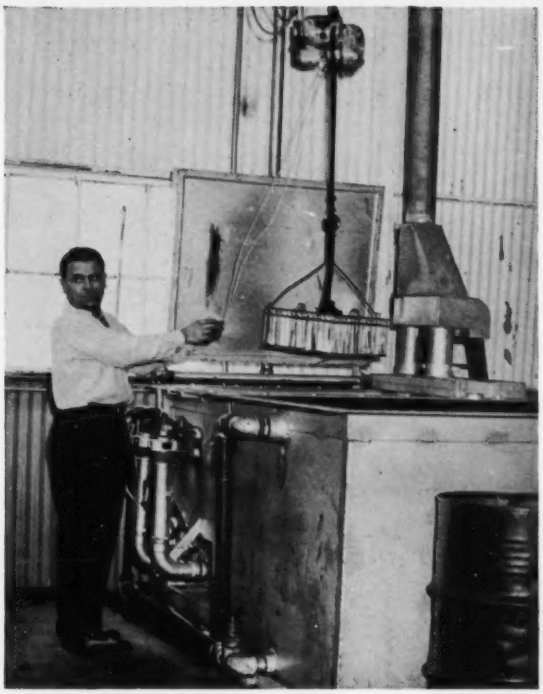
Cold forging has made it possible to produce up to 28 forgings per minute with a single machine tool without burning dies or contaminating materials with lubricants.

After being deflashed with a 15-ton press, Hycon's forged rocket fin blades are loaded in baskets as shown here so that they can be heat treated.

Aluminum strip stock is fed into a punch press which produces blanks for Hycon's new cold forgings.

Strips of 14S aluminum serve as raw materials for the cold forgings. They are rapidly, continuously, and automatically converted into blanks by means of steel dies in a 40-ton Ferracute punch press.

Leaving the 40-ton press, the blanks fall onto a belt-type conveyor which takes them to a hopper on a new 800-ton Chambersburg Cecomatic forging machine. The hopper feeds a storage bin, since the blanks have to be manually realigned on a second belt-type conveyor which feeds them into vertical



A hoist is used, as indicated here, to convey Hycon's forged rocket fin blades to the salt bath in which they are heat treated.

forging dies on the big pneumatically-powered machine.

Function of the forging machine is to form parts between Typlex steel dies with 60 psi of air pressure. The individual parts are forged as rapidly as the dies can be opened and closed.

Emerging from the forging machine, the forgings go to a third belt-type conveyor which takes them to a 15-ton Diamond punch press. There the parts are quickly deflashed with steel trimming dies and then loaded in baskets so that they can be conveyed by means of a hoist to a salt bath.

Following a heat treatment at 940°F. for 45 minutes in the salt bath, the basket-borne parts are quenched in cold water and taken to an aging oven.

In the aging oven, the parts are heated for 8 hours at 360°F. That enables the stress-relieved aluminum components to acquire mechanical properties which they could not attain in less than six months at room temperature.

The aged parts are air cooled and inspected for defects. Then those components that are in satisfactory condition are machined to critical dimensions.

Burrs due to machining are removed in a more or less conventional manner with a tumbling machine, after which the parts are drilled and reamed.

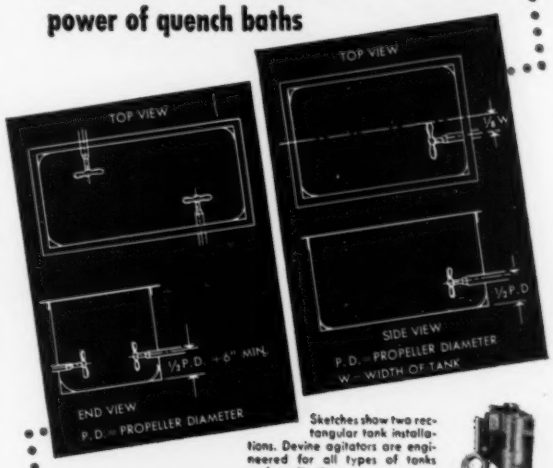
In two conclusive production operations, the parts are anodized and treated with sodium dichromate. Purpose of the sodium dichromate is to seal the anodic coatings so that they will do a more effective job of preventing corrosion. ■■■

Devine

Agitators

improve Quenching

..by greatly increasing the heat extracting power of quench baths



Sketches show two rectangular tank installations. Devine agitators are engineered for all types of tanks and applications.

Agitation Improves Quality...

INCREASED TENSILE STRENGTH
INCREASED YIELD STRENGTH
GREATER DEPTH OF HARDNESS
UNIFORM MICROSTRUCTURE

Devine agitators are sturdy, compact, self-contained . . . Easy to install, detach and maintain. They speed up quenching, improve the quality of steel and machinability of products. Consult Devine about the correct number, size, type and positioning of agitators for your tanks, quenchants, and specific requirements.

MT2

J. P. DEVINE MFG. CO.
A. M. Cox, President
49th Street and A.V.R.R. Pittsburgh 1, Pa.

For further information circle No. 3

VERSATILE CARBURIZING FURNACE PAYS FOR ITSELF IN 4 YEARS

By **W. H. WEINWURM**, *Chief Metallurgist*
Union Special Machine Company
Chicago, Illinois

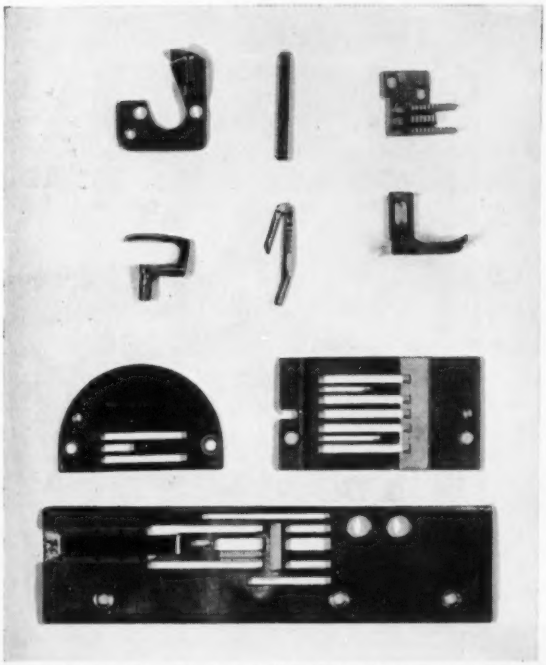
AN ELECTRODE-TYPE salt bath carburizing furnace that replaced three gas-fired carburizing pots at Union Special Machine Company, Chicago, Illinois, has saved its initial cost in four years of operation because of reduced maintenance alone. This phenomenal record is the result of much longer pot life. Used for case hardening over 100 different kinds of industrial sewing machine parts (the number of pieces with different model numbers is estimated at well over 80,000), this single heat treating furnace is used for producing case depths that vary from .005" to .0400".

Precision hardening of the thousands of parts of heavy-duty sewing machines is imperative. The parts must withstand constant vibration and wear, and operate in perfect synchronism with other pieces, some of them running in excess of 5000 rpm. This equipment has to be rugged to be able to sew such materials as heavy clothing, gloves, shoes, overalls, beddings, parachutes, tents, and awnings—in fact, all types of sewed articles.

Founded in 1881, Union Special Machine Company developed its machines around the "Double Lock" stitch. Faster and more efficient machines were developed for an ever-widening field and today the company operates factories in Chicago and in Huntley, Illinois, and in Stuttgart, Germany to meet the needs of thousands of manufacturers of sewed articles. Today, Union Special Machine is represented in some 112 industrial centers reaching all the way from Chicago to Calcutta.

Pot Lasts Seven Times Longer

Prior to the installation of the Ajax electric salt bath furnace in 1950, two gas-fired carburizing furnaces, each having pots 18" diameter x 24" deep were employed—plus one furnace as a standby. Fairly satisfactory results, from an end-product standpoint, were obtained, but pot life averaged only 1000 hours because of failures due to localized overheating. Thus, costly pot-changeovers were an expensive and repetitious occurrence. Moreover, that part of the heat treating department left much to be desired in the way of cooler working conditions and cleanliness.



Representative sampling of parts treated in the Ajax furnace. Two "loopers" are pictured in the second row from top (left side). "Throat plates" the bottom two rows.

With the Ajax furnace, having working dimensions 24" long by 12" wide by 24" salt depth, pot life is approximately 7800 hours—better than 18 months with the furnace at operating temperature 20 hours per working day. This great increase in the life of the molten salt container is due to the internal type of heating, for with closely spaced electrodes heat is supplied *directly* to the molten salt. The automatic stirring action which results from the close arrangement of the electrodes, also helps to prevent hot spots and subsequent premature pot failure. (With externally heated pots, heat must be transferred through the pot to the salt. The outside surface of the pot deteriorates rapidly because of the high surface temperatures necessary to "force" the heat through the pot.)

Versatility and Uniform Results

One typical case hardened part of SAE-1015 steel, a "Throat Plate", receives the following hardening treatments: immersion in a water-soluable carburizing salt for 15 minutes at 1575°F in the 50 Kw furnace; oil quench; wash and draw at 350°F for one hour. This cycle produces a uniform 0.005" case depth with a Rockwell hardness of case-15N-85 minimum.

Tool steel "loopers" require thorough hardening with dimensions held within 0.0015" in each of three planes. Loopers receive relief annealing, normalizing, and a spheroidizing anneal before hardening. The hardening cycle comprises immersion of the pieces for 2½ hours in the molten salt controlled at 1475°F,

Operator immersing a charge of throat plates in the 50 Kw carburizing furnace. Capacity of the furnace is 200 of these pieces.

followed by oil quenching, washing, and tempering. The completed work is file hard (Rc 60) and dimensionally well within the specified limits.

An added advantage of the hardening treatment is cleaning the surface of the work. Annealing and normalizing treatments employed prior to hardening the loopers leave a slightly decarburized surface, but liquid carburizing produces a clean metallic surface.

Disregarding the saving from reduced maintenance of the salt bath equipment, the electric salt bath furnace has well proved its worth. Closer control of the physical properties (case depth, hardness, dimensional changes, etc.) has been obtained consistently, and electrical heating has improved the working conditions by reducing the room temperature and eliminating the fumes and smoke. ■ ■ ■

For precision cleaning of molds and dies—

NEW PANGBORN HYDRO-FINISH

gives you: Fewer moving parts
Easier handling—Added efficiency

Now Pangborn's famous Hydro-Finish is yours with added convenience and efficiency! Holding fine tolerances, Hydro-Finish cleans molds and dies in minutes . . . offers many new advantages. Pangborn has done away with the pump; air jet sluriators now keep the abrasive in suspension. This means a lower investment and fewer moving parts. Optional loading stand simplifies handling, washing and inhibitor application. The cabinet has been redesigned for more efficient operation. These and other advantages make the new Pangborn Hydro-Finish ideal for precision cleaning and finishing!

For further details on Hydro-Finish, send for Bulletin 1403 now! Write: PANGBORN CORP., 3600 Pangborn Blvd., Hagerstown, Md.

Pangborn

BLAST CLEANS CHEAPER

For further information circle No. 4

Gas Analyzers for

EFFICIENT FURNACE OPERATION

By **E. C. LANG,** *Staff Engineer*
Marketing Division
Cities Service Petroleum, Inc.
New York, N.Y.

THE EFFICIENT operation of the modern heat treating furnace often depends upon the intelligent application and use of gas analyzers. Much of this equipment is panel board instrumentation, permanently installed, and providing controlled combustion by measuring or recording one or a mixture of furnace gas constituents. The furnace engineer, however, is faced with numerous problems that demand detailed investigations of combustion conditions in all phases of the combustion process in all parts of the furnace. Their solution often requires the use of a flexible, portable type of gas analyzer that will provide the necessary combustion information in a practical, usable manner.

Fig. 1—Cities Service Industrial Heat Prover.

The Industrial Heat Prover

The Cities Service Industrial Heat Prover (see Fig. 1) is designed specifically for this purpose. The instrument is part of an engineering service offered to industrial customers of the Cities Service Oil Co. Since its introduction more than fifteen years ago it has found widespread application in many diversified industries.

In developing the Heat Prover, our research engineers recognized the need for a dual scale instrument that would measure the two controlling constituents of furnace gases: oxygen and combustible gases. A combustion analysis is thereby obtained for conditions of air deficiency (excess fuel) as well as air dilution (excess air). The immediate effect of changes in any of the variables influencing combustion is indicated by the "in step" and "in phase" continuous response of the Heat Prover. The fact that the instrument is lightweight and compact and may be carried conveniently around the furnace area has greatly extended its usefulness. It is an invaluable aid for adjusting air-fuel ratios, for measuring furnace atmosphere quality and for pinpointing where combustion faults exist and where greater efficiencies can be realized by corrective maintenance.

Operation of the Analyzer

The Heat Prover is a self-contained unit, weighing approximately 25 lbs. and is operated from a 105-103 volt, 25-60 cycle A.C. power source. Auxiliary equipment includes a sampling tip, sampling hose and a thermocouple for temperature measurement. A schematic diagram of the Heat Prover circuit is shown in Fig. 2.

A steady flow of sample is drawn into the instrument by a rotary pump. After passing through a filter, the pump delivers sample simultaneously to both the oxygen and combustible analyzing sections of the Heat Prover.

The sample flowing into the combustible section is first mixed with air and then pumped through the active cell of the combustible analyzer. A hot wire

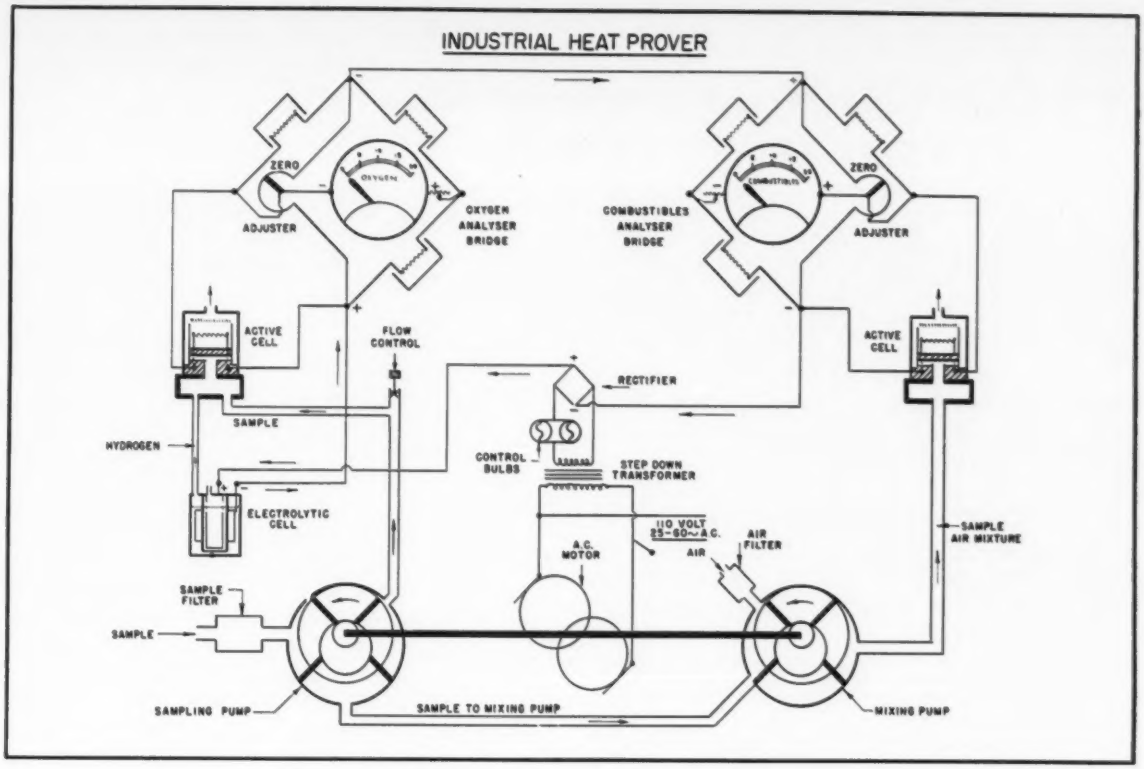


Fig. 2—A schematic diagram of the Heat Prover circuit.

platinum catalyst suspended within the cell forms one arm of a Wheatstone Bridge circuit. The air-sample mixture burns at the surface of the wire thereby increasing its temperature and electrical resistance in proportion to the volume percent of combustible gases in the original sample. This change in electrical resistance is measured by the Wheatstone Bridge and the bridge meter reads directly in "Percent Combustibles".

The sample flowing into the oxygen section is mixed with hydrogen gas generated by an electrolytic cell. The hydrogen-sample mixture passes through the active cell of the oxygen analyzer. Any oxygen present in the mixture burns with the hydrogen at the surface of the platinum wire of the cell. A Wheatstone Bridge circuit is again used to measure the change in electrical resistance of the wire. The bridge meter in this case reads directly in "Percent Oxygen".

The oxygen and combustible meters have 4% and 20% scales. This dual range feature affords a wide range of measurement and provides greater accuracy and sensitivity. The oxygen meter is provided with an additional scale for reading the output of the thermocouple. The operation of the Heat Prover is entirely automatic. Scale ranges are selected by operating the range switches located below each meter.

Fundamentals of Combustion

At this point a review of combustion fundamentals will be helpful in understanding the interpretation and use of the Heat Prover readings in actual combustion practice.

Table I lists the gas volumes involved in the perfect combustion of a cu. ft. of a natural gas fuel. Computation of these volumes is based on the chemical reactions of oxygen with methane and ethane, the heat producing constituents of the fuel.

$$CH_4 + 2O_2 \longrightarrow 2H_2O + CO_2$$
$$C_2H_6 + 3.5O_2 \longrightarrow 3H_2O + 2CO_2$$

In actual practice the complete combustion of a cu. ft. of a natural gas will require an air supply greater than the theoretical air requirement of 10.28 cu. ft. The amount of air supplied in excess of this value is called excess air. This air mixes with the total combustion products in the furnace exit gases.

When less than 10.28 cu. ft. of air is supplied, the fuel is incompletely burned and the incompletely burned gases, H_2 and CO are evolved. The furnace gases for this case of air deficiency contain both complete and incomplete products of combustion.

(Continued on page 28)

CONTROLLED ATMOSPHERE INSTRUMENTATION

By **R. R. SWAIN,** *Manager*
Iron & Steel Division
Bailey Meter Company
Cleveland, Ohio

CONTROLLED protective atmospheres are vital to the heat treating process. For uniformly high quality steel, produced safely and economically, instrumentation must be complete on both the atmosphere generator and the annealing furnace.

Quality of Prepared Atmosphere

The quality of prepared atmospheres must be uniform; unfortunately, the quality of fuel burned to produce this gas is variable. It is desirable, therefore, to have precise fuel-air ratio control.

Adjustment of the fuel-air ratio may be done by a Bailey Fuel Flow-Air Flow Ratio Controller or, by a zero governor as shown in Fig. 1. In this arrangement a vernier adjustment is achieved by shunting a small portion of the gas flow around the zero governor. The by-pass fuel valve is controlled by the gas analyzer which measures the per cent combustibles in the gas leaving the combustion chamber.

The combustibles analyzer operates on the catalytic combustion principle. The continuous sample of gas is mixed with air and passed over a heated filament. Whatever combustibles are present will burn, raising the filament temperature. This difference is detected by an electric bridge circuit, continuously recording in terms of per cent combustibles and, in this case, used to control the by-pass fuel valve.

An Annealing Application

In a typical annealing application, a continuous line of silicon strip steel is treated in an electrically heated furnace divided into a heating and cooling zone.

(Continued on page 14)

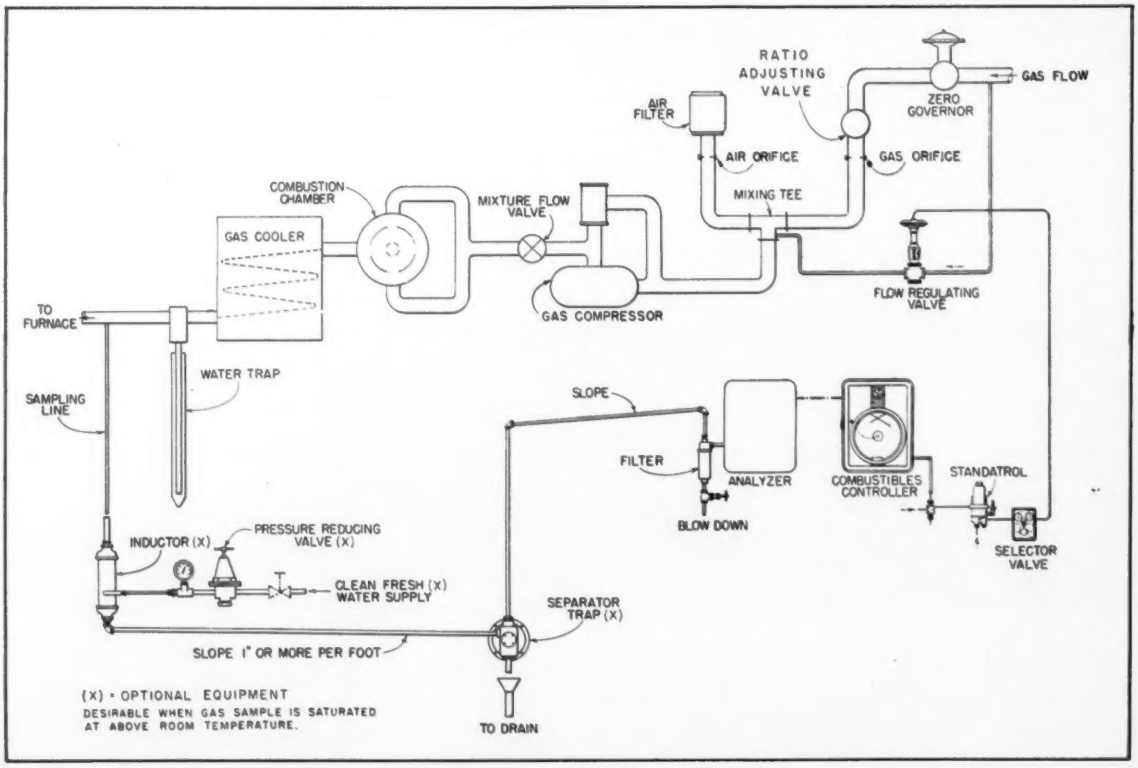
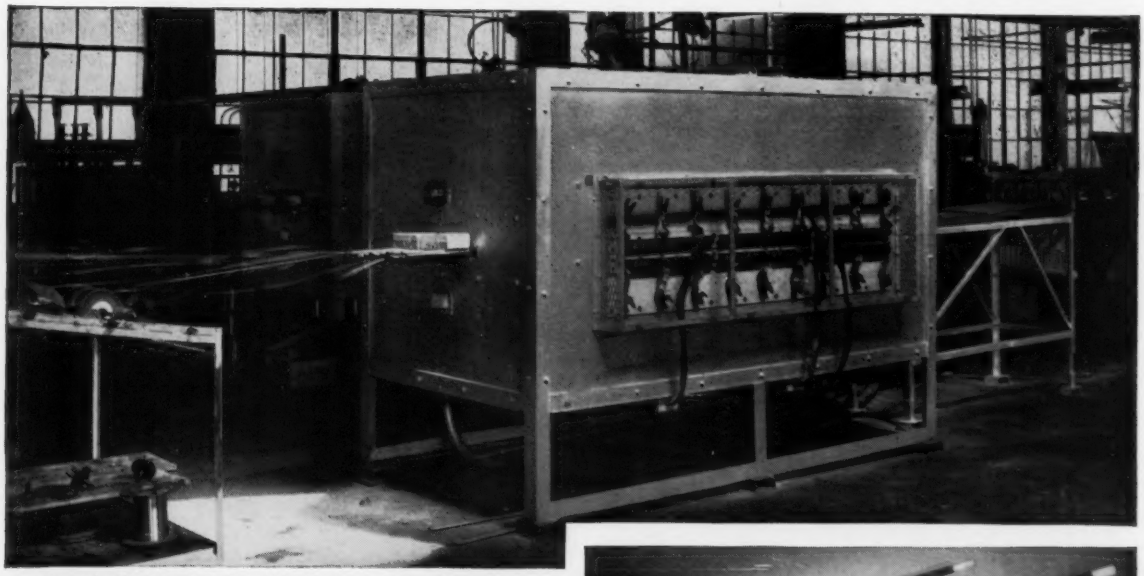


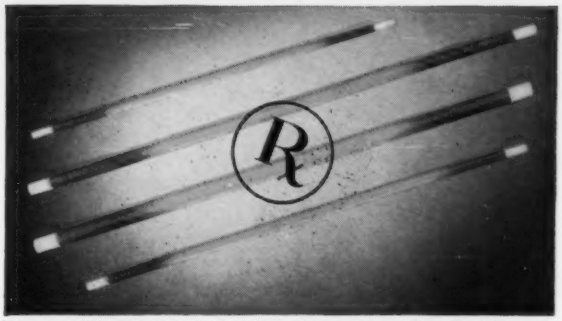
Fig. 1—Schematic drawing showing combustibles control for atmosphere generator.

More proof that "HOT RODS" last 3 times longer



Completely Equipped With "Hot Rods" after Norton CRYSTOLON heating elements proved their ability to outlast others 3 to 1. This electric furnace is one of a battery operated by the Alloy Metal Wire Division of H. K. Porter Company, Inc. of Prospect Park, Pa., for bright annealing alloy wire at 2150F. Heating elements operate in an air atmosphere, while the wire passes through tubes containing a controlled split-ammonia atmosphere. These furnaces idle at 1700F-1750F on weekends and holidays, so element service is continuous.

Alloy Metal Wire Division H. K. Porter Company, Inc. converts to CRYSTOLON heating elements after tests prove superiority of latest Norton Rx*



Norton CRYSTOLON Heating Elements, or "Hot Rods", are a typical Norton Rx — an expertly engineered refractory prescription for greater efficiency and economy in electric kiln and furnace operation. Made of self-bonded silicon carbide, each rod has a central hot zone and cold ends. Aluminum-sprayed tips and metal-impregnated ends minimize resistance and power loss. Available in standard sizes.

Like many another new user of "Hot Rods" the Alloy Metal Wire Division of H. K. Porter Company, Inc. found that these Norton CRYSTOLON heating elements last much longer. Here is a summary of the tests responsible for this company's decision to make a complete change-over to "Hot Rods."

Electric furnaces at the company's Prospect Park plant are used for bright annealing alloy wire at 2150F. Previous heating elements had given approximately 4 to 6 months service with 3,048 hours as the best recorded service life. Then, in a furnace completely equipped with "Hot Rods" the Norton elements averaged 18 months of continuous service — or over 13,000 hours per element. Once again "Hot Rods" proved their ability to outlast competitive elements — by better than 3 to 1!

But that's not the whole economy-story. The much longer life of "Hot Rods" also means savings in element costs, because fewer "Hot Rods" are needed — *plus* reduced maintenance, due to less frequent changing — *plus* fewer changes in voltage taps — *plus* a smoother production flow.

Put these advantages to work for YOU

in your own electric furnaces or kilns. The big illustrated booklet, *Norton Heating Elements,* gives complete details on how this proved Norton Rx cuts operating and maintenance costs. For your copy, write to NORTON COMPANY, 631 New Bond Street, Worcester 6, Mass.

For further information circle No. 5

NORTON

REFRACTORIES

Engineered... Rx... Prescribed

Making better products... to make your products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

(*Continued from page* 12)

It is necessary to provide proper flow of protective atmospheric gas to insure a positive pressure in each zone and prevent infiltration of air. Bailey Oxygen, Combustibles, and Hydrogen Recorders may be used for each zone (See Fig. 2).

The Bailey Oxygen Anaylzer-Recorder operates on the same principle as the previously mentioned Combustibles Analyzer. Hydrogen fuel is burned on a heated filament supported by whatever oxygen is present in the gas sample.

The Oxygen Recorder is used to record the oxygen in the furnace during the purge cycle. Purging of the furnace when starting is necessary to guard against an explosion. By using the Oxygen Recorder, the operators can tell when the oxygen content is reduced to a point where it is safe to start up the heating of the furnaces. (Purging is accomplished with NX gas which is about 2% carbon monoxide, 2% hydrogen and 96% nitrogen.) After purging it analyzes the incoming NX gas. Other instruments used on this annealing furnace include Bailey NX Gas Flow Meter, Disassociated Ammonia Flow Meter and Bailey Furnace Pressure Recorder.

As a result of this instrumentation, the purge time can be reduced considerably. Steel quality is uniformly high and high production is maintained.

Measuring Oil Flow

Rate of oil flow may be measured by the Bailey Area Meter shown in Fig. 3. Installed directly in the oil line, the Area Meter operates with a constant differential pressure across the variable area metering ports. The area of the rectangular ports varies with the height of the metering plug. The differential pressure across the plug is balanced by either a calibrating weight or a spring. As the rate of flow increases, the increased differential pressure raises the plug, increasing the port area. This movement of the metering plug is detected and transmitted either electrically or pneumatically to Bailey Indicators, Recorders and/or Controllers. ■ ■ ■

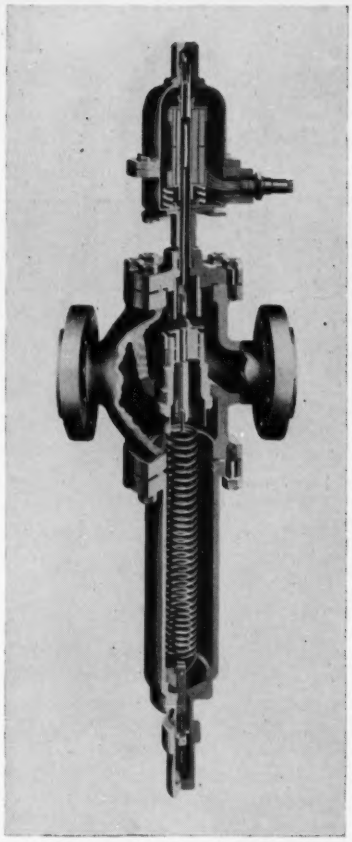


Fig. 3—Cutaway view of the Bailey Area Meter for oil flow measurement. Measures the rate of oil flow and transmits to a receiver-recorder.

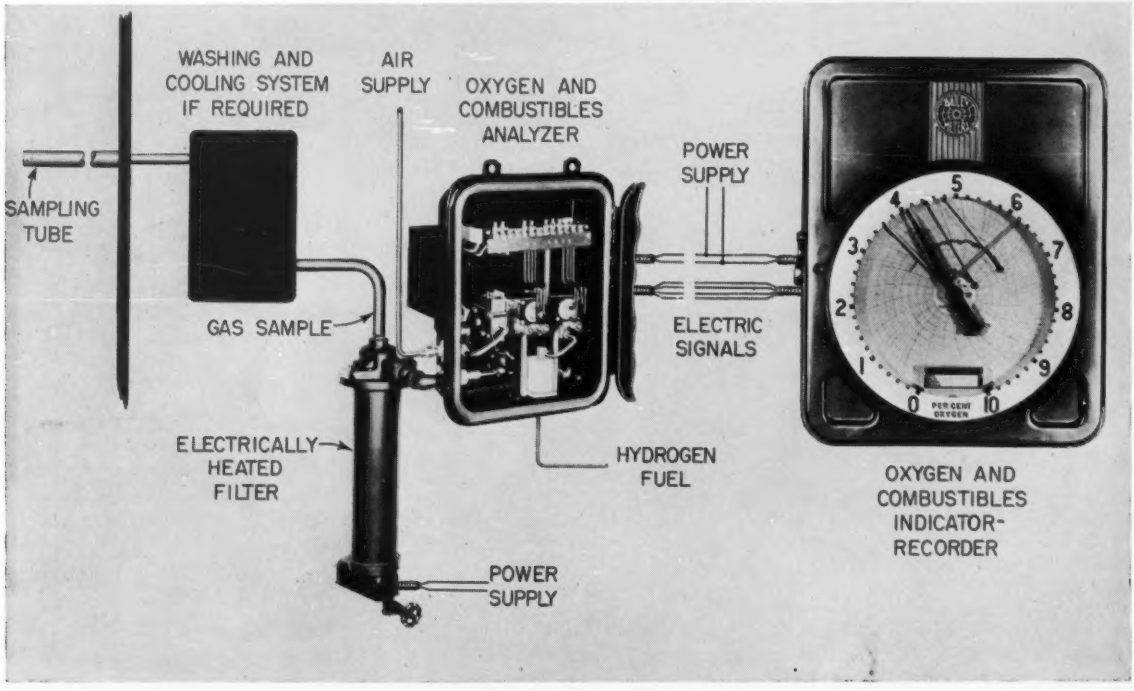


Fig. 2—Oxygen, Combustibles, and Hydrogen Analyzer.

THERMALLOY* APPLICATION ENGINEERING AT WORK

The Curtiss-Wright turbo-compound aircraft engine, showing the valve guide which is cast of an Electro-Alloys anti-galling, heat and abrasion-resistant alloy. This engine is used in many powerful transport aircraft.

This special alloy

resists abrasion . . . at high temperature

The original problem arose when Curtiss-Wright Corporation, Wood-Ridge, N. J., required an alloy for valve guides which would reduce oxidation at high temperatures and improve valve stem durability. The Electro-Alloys metallurgical staff tested many alloys, selecting the one proved best for the job.

It is a hardenable, machinable, cast alloy which resists oxidation up to 1800°F (982°C), and it can be drilled or tapped. This alloy has excellent abrasion resistance. It is being used with particular success in valve guide applications. This same alloy is also being used in pump shells, burner nozzles and other parts which must resist heat and severe abrasion.

Their work in new alloy development and extensive experience in the application of existing alloys to solve complex problems qualify the Electro-Alloys engineering and metallurgical staff for tough assignments. If you face the need for high heat-resistant castings, call our nearest representative, or write to us in Elyria.

*Reg. U. S. Pat. Off.

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ELECTRO-ALLOYS DIVISION

6003 TAYLOR ST., ELYRIA, OHIO

Sales offices in: Los Angeles, Oakland, Chicago, Detroit, New York, Cleveland, Philadelphia, Pittsburgh

For further information circle No. 6

Right Or Wrong In

LABOR RELATIONS

By **LAWRENCE STESSIN**

Can a Senior Worker Exercise His Seniority Right to Transfer to Another Job in the Same Classification?

What Happened:

Bob Herman and Ed Garaway worked near each other. Both were on jobs which had the same labor grade, though the duties and responsibilities differed somewhat. Bob took sick and had to quit. This left a vacancy open for his job. The supervisor, as was common practice in this department, posted a notice and asked workers to bid for the job. Usually the senior employee was given preference provided he had the skill and experience to qualify. Garaway put in his bid for the opening on the grounds that he was senior man in the department and knew the operation well. His supervisor refused to make the transfer. He claimed that Garaway was already in the same classification as the opening and that a man cannot demand a transfer to a job which pays about the same rate and is *not* a promotion. If this were possible, the foreman claimed, it would upset the routines in the company. The reason they have "bidding for jobs" is to give a lower-rated man a chance to climb up the ladder.

Garaway said "no soap." He argued that the vacant job had many advantages he didn't enjoy although he was in the same labor grade. For one, the job usually had more overtime. Two, it was cleaner work and three, the incentive earnings were slightly better. "If you promote a junior man into that vacancy," Garaway held, "you are giving him an advantage over me" (which is a violation of the seniority principle.) "If you want to promote a junior man, give him *my* job and I'll take the one left open by my friend Bob."

Was Garaway: RIGHT ☐ WRONG ☐

What Arbitrator B. Meredith Reid Ruled:

"Promotions were never intended to mean that an employee can select a machine or pick a job in situations where such related tasks pay the same rates. Management has the sole right to make transfers as a necessary element in the operation of its business. Upgrading connotes an upward movement to a higher classification requiring superior skill or more work, and entails higher pay. The opening left by Bob Herman's quit had none of these so Garaway is not entitled to exercise his seniority. Grievance denied."

If a Worker Is Suspended as a Disciplinary Measure, and a Paid Holiday Falls During That Period, Can He Collect?

What Happened:

Frank Bloom was a man of hot temper. One day he got into an argument with another worker. One word led to another, and losing his head, Bloom took a swing and landed a haymaker. The company thought of firing Bloom, but upon investigation it couldn't determine who started the argument. As a penalty for his hot-headedness, however, Bloom was given a two-week layoff without pay. The two weeks ended on a holiday, Thanksgiving Day.

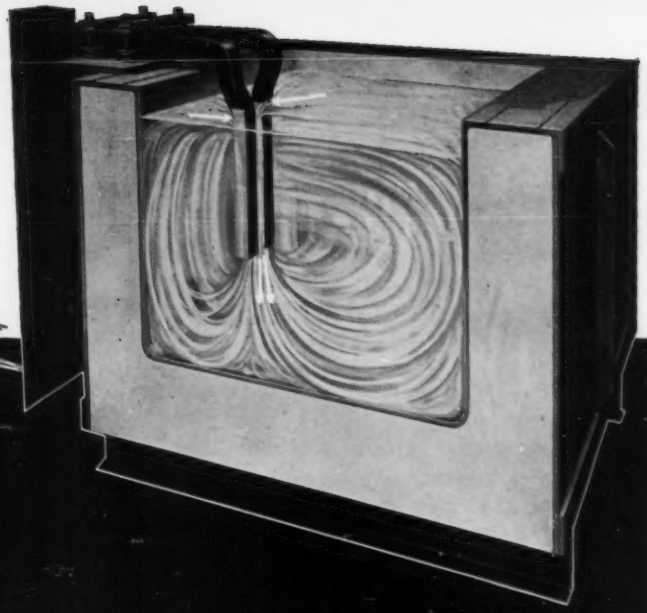
The company had a policy (as do many these days) that a worker must be on his job the day *before* and the day *after* a holiday in order to be eligible for holiday pay. This is to discourage "three-day holidays." When Bloom returned from his suspension and found that he was not paid for Thanksgiving Day, he raised a fuss. The company pointed to its policy which said that a man must be "scheduled or assigned" to work prior and after a holiday to get paid. Since Bloom was on suspension he was not "scheduled or assigned" and couldn't qualify for Thanksgiving Day money.

Was the Company: RIGHT ☐ WRONG ☐

What Arbitrator Joseph Brandschain Ruled:

"It is true that Bloom was absent from work on the last day prior to a holiday. However he was not absent from work *by his own accord*. The company, by suspending him from November 13th to November 26th had, in effect, "unscheduled and unassigned" him on these days. He is therefore entitled to be paid. Grievance granted."

Suspended-electrode type furnace

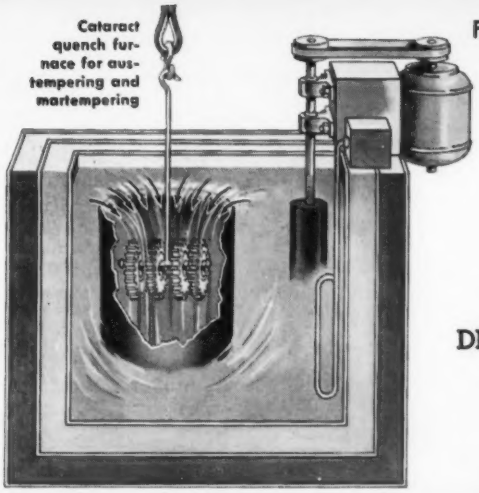


AJAX®

HULTGREN

Salt Bath Furnaces

Cataract quench furnace for austempering and martempering



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For further information circle No. 7

NEWS TO HEAT TREATERS...

Alkaline Compound

DU-AL #489—a new, unique multi-purpose alkaline compound that removes rust, scale, paint, grease, oil, etc. in one operation has been developed by the Chemclean Products Corporation, Brooklyn, N. Y.

Some of the advantages claimed for the new product are: Non-corrosive to sound ferrous metals; can be used as a soak or electrolytically with reserve or direct current; eliminates the possibility of hydrogen embrittlement caused by acid descaling; eliminates the need for acid pickling in rust removal; and it eliminates acid disposal problems.

For further information circle No. 8

Mass Spectrometer

A new mass spectrometer, recently installed at U. S. Steel's Applied Research Laboratory in Pittsburgh, Pennsylvania, analyzes gases and vapors by smashing their molecules into fragments and weighing the resulting atoms and radicals. In the illustration, a research scientist has

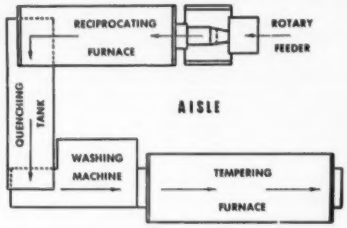
the spectrometer set for process monitoring. The graph shows a tracing and retracing of a peak of one given mass.

This is said to be the first instrument of its kind to be used in the steel industry.

For further information circle No. 9

Automatic Furnace Installation

The American Gas Furnace Company of Elizabeth, New Jersey is now supplying completely automatic continuous heat treating installations with production capacities from 100 pounds per hour up to 800 pounds per hour. The wide range of sizes available permits the small plant or the individual pro-



duction line to utilize a continuous automatic installation for heat treating, quenching, washing and tempering, thus reducing costs.

The fully automatic installation comprises a new AGF Automatic Rotary Feeder, an improved Controlled Atmosphere Reciprocating Furnace, Quenching Tank, Washing Machine and Tempering Furnace.

The installation can be made either "in line" or in a "reversing loop", as shown below. The "reversing loop" permits discharging the work immediately adjacent to the charging end of the furnace and requires minimum floor space.

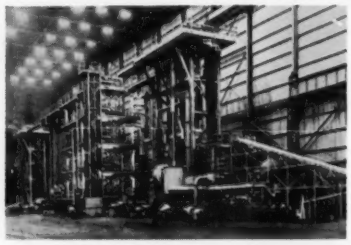
The automatic heat treating facility is said to assure uniformity of processing. Each work piece as it passes through the reciprocating furnace receives its own individual heat treatment, quench, wash and temper. Flexibility permits handling small as well as large production lots on a continuous basis. Large production runs can be easily interrupted to permit processing small batches of work more urgently needed. Versatility permits clean hardening, light case carburizing, etc. without any modification.

For further information circle No. 10

30 Tons Per Hour Annealing Line

A new continuous, automatic annealing line at the Fairless Works of U. S. Steel Corp., achieves cleaning and annealing of strip steel at the rate of 1,000 feet per minute.

Powered by a General Electric Company drive system and featuring a giant G-E vertical annealing



furnace, the line anneals 30 tons every working hour.

The furnace, manufactured by G. E.'s Industrial Heating Department, is said to be among the world's largest vertical units and can handle strip steel from 18 to 37 inches in width.

The new cleaning and annealing line was designed and built jointly by U. S. Steel, the United Engineering and Foundry Co., and G. E. Its utilization of vertical loops enables the accommodation of 3,000 feet of strip in a floor length of 385 feet.

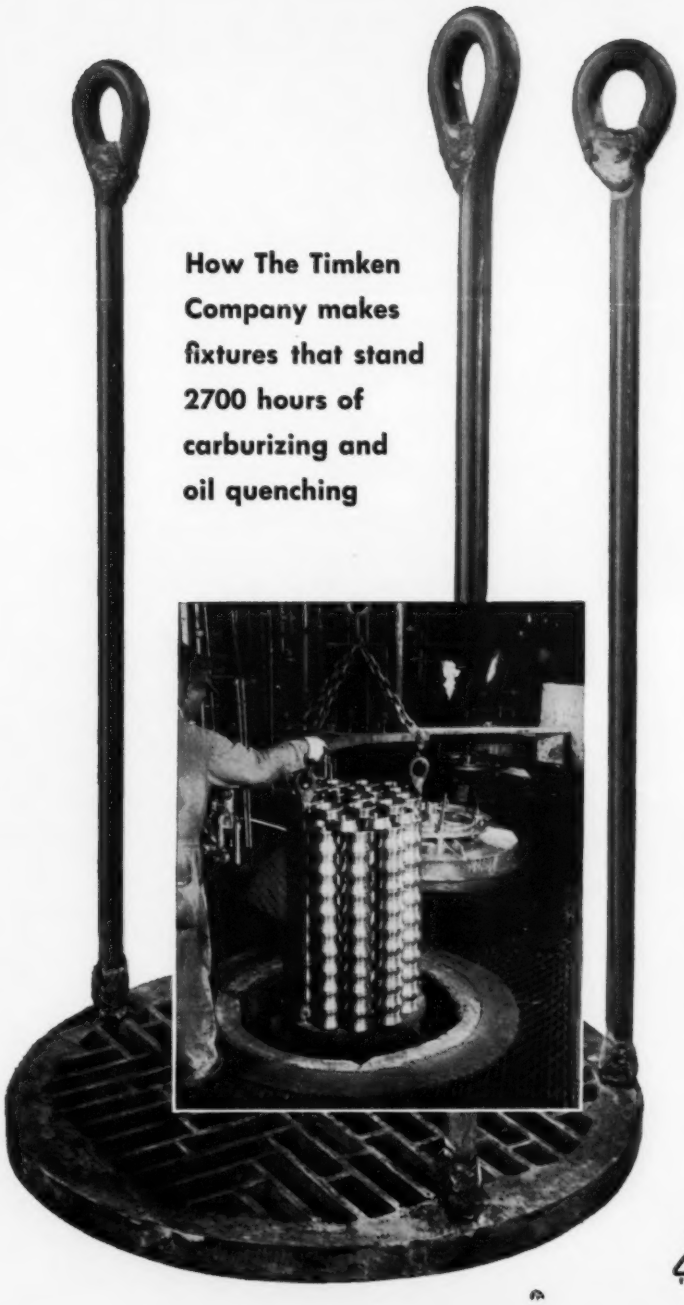
For further information circle No. 11

Robert S. Haff, Jr.

Norton Company regrets to announce the death of Robert S. Haff, Jr. of its Refractories Sales Engineering Department. Mr. Haff, who was 39 years old, had been with Norton Company since 1951. Previously, he had been with Walsh Refractories and Hartford Empire Company. He received both his Bachelor's and Master's degree in ceramic engineering from Virginia Polytechnic Institute.

(Continued on page 24)

Service life doubled ...with Inconel



How The Timken Company makes fixtures that stand 2700 hours of carburizing and oil quenching

How long do *your* quenching fixtures last? And how much do they have to take? Perhaps the experience of The Timken Roller Bearing Company can help you save on replacement costs.

Roller bearing parts at The Timken Company are carburized in natural gas. This heat treatment is followed by an immediate oil quench.

During the whole process the parts are carried on a fixture consisting of three Inconel® eye-bolts welded to a grid. Formerly, under the corrosive conditions and severe thermal shock, eye-bolts only lasted an average of 1350 hours.

With Inconel, The Timken Company finds the service life of these eye-bolts has been doubled, and better. Some last up to 3700 hours.

This is possible because of Inconel's combination of valuable properties: its strength at high temperatures, its excellent resistance to oxidation and corrosion, and to thermal shock.

With these factors present, fabricated, well designed Inconel equipment is the logical choice for heat treating service followed by quenching. Of further importance, Inconel, despite its strength and toughness, can be readily formed. It is also easy to weld by any of the commonly used methods.

Try Inconel. You'll find, like The Timken Roller Bearing Company, that it is a high temperature alloy that gives long service under severe conditions. And for many suggestions on practical ways to make Inconel heat treating equipment write for our booklet, *Keep Operating Costs Down . . . When Temperatures Go Up.*

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys**

Inconel . . . *for long life at high temperatures*

For further information circle No. 12

HEAT TREATING HINTS

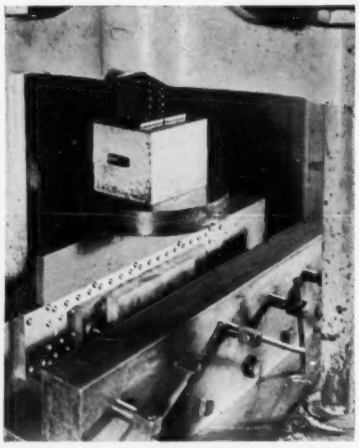
Distortion

Innumerable methods of controlling distortion or size change during heat treating have been presented in technical journals or in advertising literature. Most of these, however, deal largely with either rigid quenching fixtures, as for example a Gleason quenching press, or special quenching procedures such as austempering and martempering.

The former method is strictly a production tool and the high initial outlay for fixtures is justified if the quantity of parts involved is substantial or the cost of manufacture of the items is expensive. Martempering and austempering are usually production techniques; for example, the heat treating of roller bearings, artillery shells, etc. The furnaces are often of the continuous type, although a good deal of batch-type work is done.

Very often, however, a wide variety of tools and dies are either too long and slender or of such a section that even martempering or austempering in proper equipment fails to hold deformation within acceptable limits. Therefore, the use of fixtures during the martempering procedure to keep the parts within the distortion limits is frequently required.

In an effort to provide a simple but universal unit, a screw press and a heavy "U" fixture with side screws have been adapted in our plants, to hold parts within limits in cooling from the specified martempering bath temperature to complete transformation. (See cut)



Excessive salt is wiped off during transfer from the salt bath to the quenching fixture.

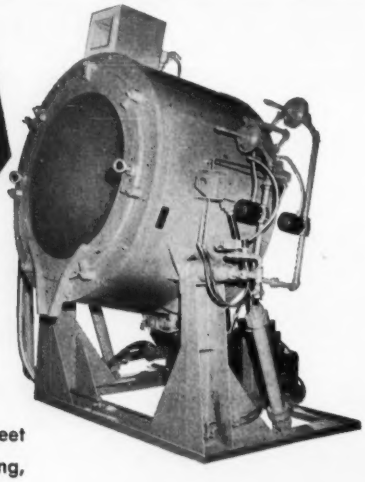
A wide variety of unusual sizes and shapes can be processed in this fashion to overcome warping troubles. By the use of various sizes of back-up plates, many rectangular or angular parts can be held to extremely close distortion limits. "Vee" blocks of two or three different sizes may be used to accommodate a wide variety of rounds.

SCORE A BULL'S-EYE

with

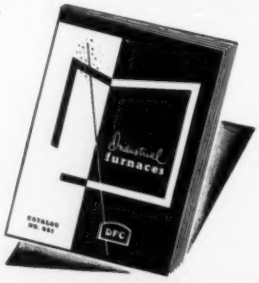
efficiency engineered

DFC FURNACES



There's a DFC furnace to meet each of a wide range of melting, testing, forging and heat-treating requirements. Typical is the Tilting, Pot-Type Kirksite Melting Furnace shown. 14 cu. ft. pot...hydraulic tilting mechanism... proportional gas-air mixer...first quality insulating refractory lining. Tops in efficiency and long life.

WRITE FOR CAT. 601
or
check with your DFC Dealer
..giving your requirements.



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For further information circle No. 13

The device has proved of great value in our daily handling of work of this sort.

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Annual

Achievement Award

To be made at the discretion of a Committee appointed to select the Best Article appearing in Metal Treating magazine or Lecture presented at any meeting of the Institute.

Next year's award shall be presented at the 1956 *Annual Meeting of the Institute and all Articles appearing in any issue of Metal Treating from September-October* 1955 *to July-August* 1956, *or any Lectures presented at the* 1955 *Annual and* 1956 *Spring Meetings are eligible for consideration.*

"WHAT JOKER THREW THAT BUBBLE STUFF IN THE SALT BATH ?!!"

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Molten Aluminum PROCESS

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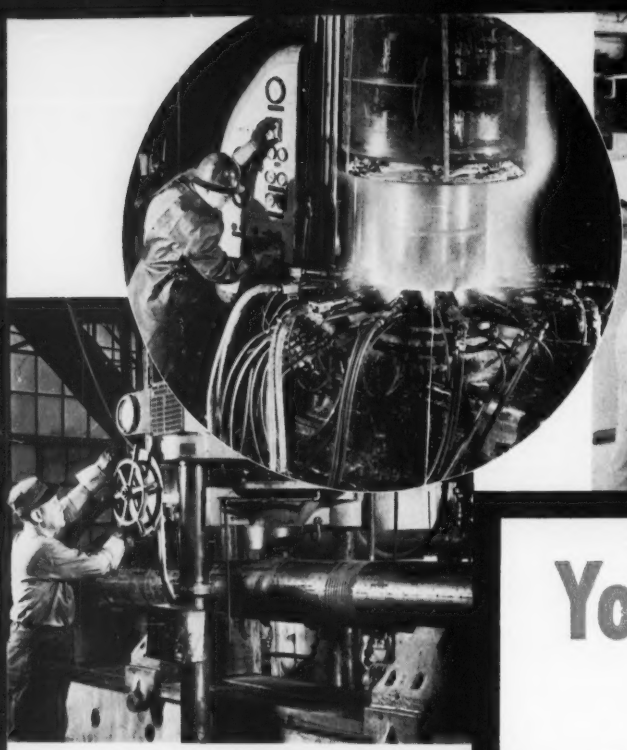

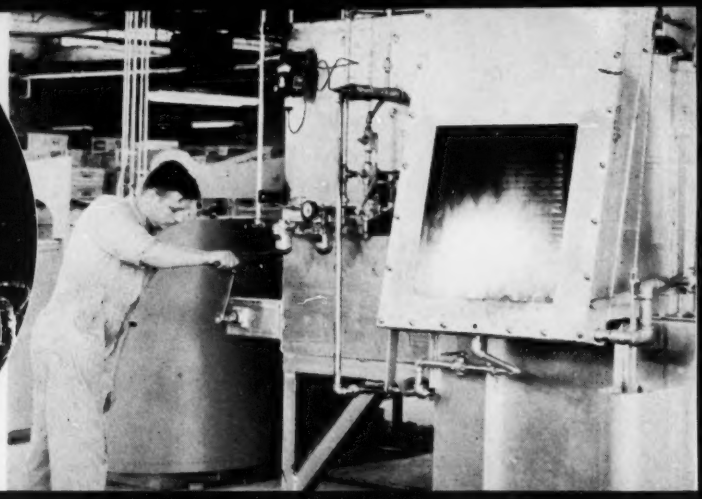

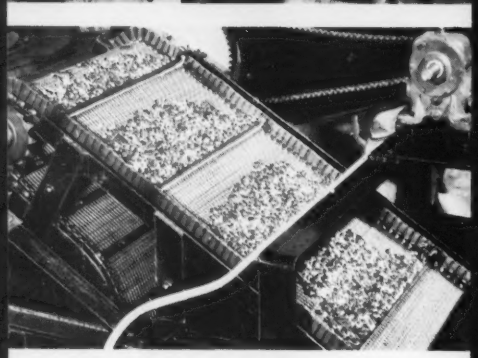

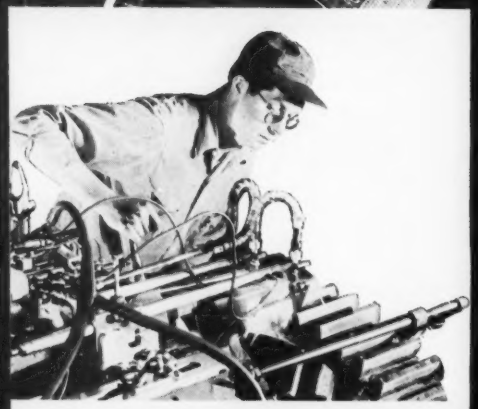

You need MORE than these to Heat Treat Metals!

The science of heat treating has become of vital importance to many manufacturing operations. Without the radical improvements of the properties and characteristics achieved in metals and alloys by heat treating, many of the nation's most important products could not be made.

To perform the appropriate type of heat treatment, such as annealing, normalizing, quenching, tempering, carburizing, controlled atmosphere hardening, stress relieving and others requires specialized, intricate, and expensive equipment such as is illustrated here.

But *more* than such equipment is needed. The most modern and highly specialized equipment is useless without the correct combination of operational skill and technical experience that has been developed over years of practical operating practice. Equipment and materials are important, but the *essential* factor in heat treating operations of all kinds is the human touch and the practiced hand.

The members of the Metal Treating Institute listed here are the recognized leaders of the commercial heat treating industry. They are specialists possessing the equipment, the technical skill, the years of experience, and the personnel with which to solve your heat treating problems all under one roof.

When you need complete heat treating services or want consultation concerning heat treating or engineering or design problems, write any of the companies listed. All inquiries will receive prompt attention.

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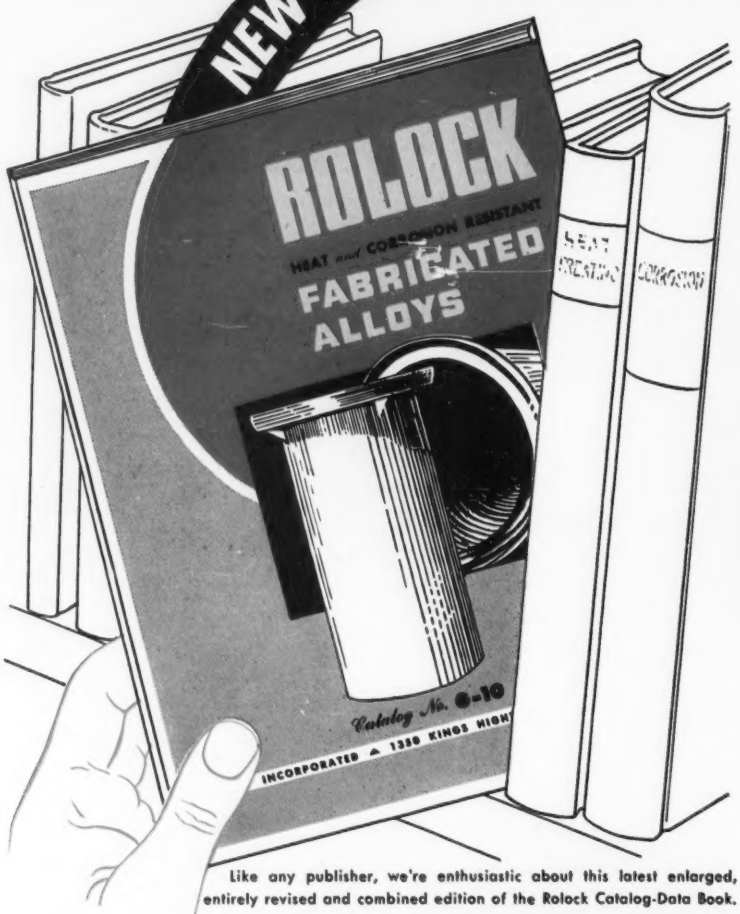

Like any publisher, we're enthusiastic about this latest enlarged, entirely revised and combined edition of the Rolock Catalog-Data Book.

Here you will find the most completely illustrated and described listing of fabricated-welded alloy Heat and Corrosion-Resistant Equipment yet to be published. Included are many unique major improvements and advances in design and construction of muffles, retorts, pit-type furnace equipment, salt bath equipment, pickling equipment and processing equipment, never before shown. One or more copies should be ordered immediately for your information and reference. Use the coupon or your letterhead. No cost or obligation.

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For further information circle No. 16

NEWS TO HEAT TREATERS

(Continued from page 18)

Portable Dewpoint Indicator

A new, portable, manually-operated dewpoint indicator for easy, convenient measurement of moisture in gases has been announced by General Electric's Instrument Department at Lynn, Mass.

Designed for applications where only periodic checks of dewpoint are desired, the indicator determines the moisture content of a

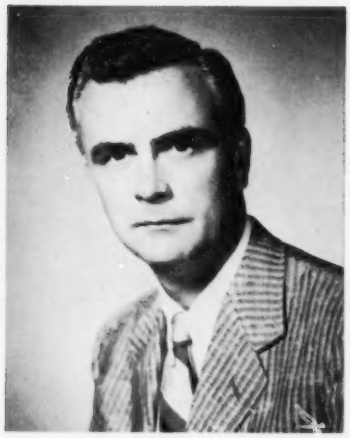
gas by measuring the temperature at which the moisture begins to condense. This is done by cooling a mirror surface and observing the temperature at which dew first forms. The dewpoint temperature directly describes the water vapor content of a gas.

It is said to be especially useful for monitoring the moisture content of furnace atmospheres in the heat treatment of metals. The indicator gives accurate readings over the range of dewpoint temperatures from ambient to -100°F. (0.0003% moisture by volume in air). It requires no electrical outlet, operating on a self-contained battery, and can be used to measure different gases in rapid succession. Weight is 16 pounds.

For further information circle No. 17

General Sales Manager

Robert N. Lynch has been appointed general sales manager of Park Chemical Company, Detroit,

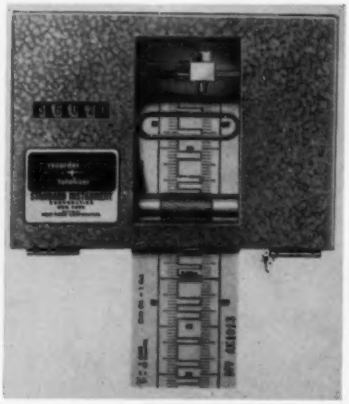


Michigan, manufacturer of chemicals for the metal working industry.

In the sales department since 1940, Lynch was made industrial division sales manager in 1949.

Time Recorder + Totalizer

The Heat-Timer Corporation, New York, N. Y., has announced the TIME RECORDER+TOTALIZER, which provides a continuous operation record of any electrically-operated machine or process. Chronologically marked tape, from a large roll, continuously passes through this instrument recording the time and length of every "on,"



every "off" period of the equipment. A glance at the tape gives all the information about the operation of the machine or process being monitored. An additional feature is the totalizer, which gives a total of the complete "on" time of the equipment.

It can either be installed as an integral part of the equipment, as remote installation, or as a portable tool. Standard tape speeds available are: one inch per 5 min.; one inch per 15 min.; one inch per hour.

For further information circle No. 18

A Pickling Operators Offer

Atlas Mineral Products Company, Mertztown, Penna., has announced an offer to all metal working plants employing pickling operations. The offer will give the industry an opportunity to test Atlas corrosion-proof cements in their own pickling tanks without obligation.

In brief, anyone using pickling in their metal working operations can obtain a sample briquette from the company joined with corrosion-proof cement recommended for the type pickling solution employed. The company suggests that the briquette, an hourglass shaped acid brick joined with the corrosion-proof cement, be suspended in the tank for "a week . . . a month . . . a year . . . as long as you wish". After the desired period of time, the briquette is to be examined carefully. If the cement is to be successful in actual installation, the sample briquette must show no sign of wear or deterioration, the manufacturer claims.

Plans are presently under way to follow-up this offer with another program for the same group. The second program will give the industry an opportunity to try the cement and test the mixing qualities and physical properties for themselves in a series of simple job site tests.

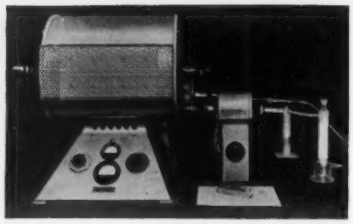
For further information circle No. 19

For further information circle No. 20

Hydrogen-Determinator

Ledoux & Company, Teaneck, N. J. announces that its new Hydrogen-Determinator is commercially available.

They state that its new Hydrogen-Determinator – based on the combustion technique–reduces the time per determination to 20 minutes in a wide variety of metals, including Titanium, Zirconium, Cerium, Tantalum, Niobium, Molybdenum, Tungsten, Nickel, Cobalt and their alloys. It determines Hydrogen in concentrations as low as .003% and as high as those occurring in metal hydrides. Accuracy by the combustion method is asserted to be equal or superior to other methods. The Hydrogen-

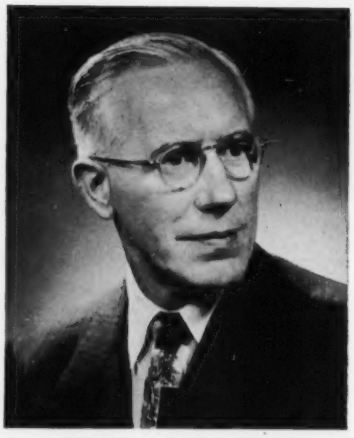


Determinator is so simple that any competent technician can operate it. No vacuum is required. The method is reproducible and accurate. A large sample (up to 10 grams) can be taken giving better representation in unhomogeneous materials. The instrument is low in cost of operation. This apparatus can also be used to determine carbon and sulfur.

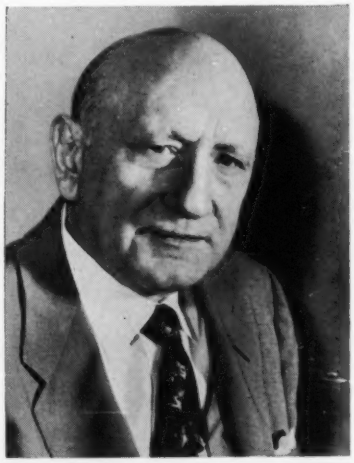
For further information circle No. 21

New Vice-Presidents

Henry M. Heyn and Albert L. Hollinger have been elected Vice Presidents of Surface Combustion Corporation, Toledo, Ohio, according to an announcement by Frank H. Adams, President of the company.



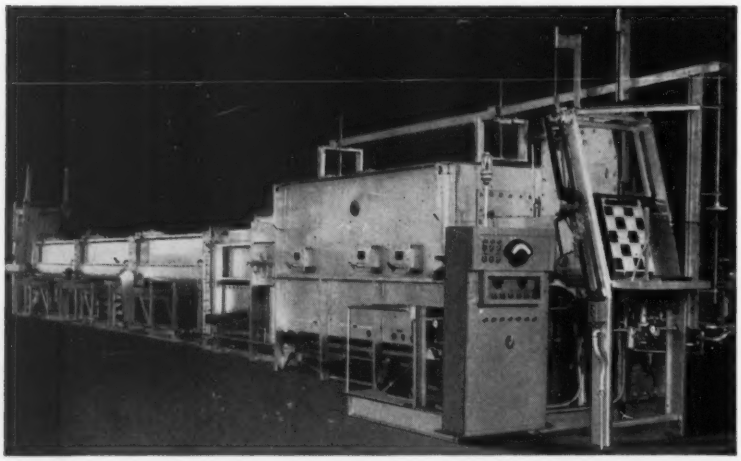
Mr. Heyn has been Sales Manager of the Heat Treat Division since 1930.



Mr. Hollinger has been Manager of the Steel Mill Division since 1930.

(Continued on page 32)

If you can keep your head when all about you are losing theirs–maybe you just don't understand the situation!



Harper Automatic Conveyor Belt Electric Furnace with sequence of operations automatically timed and synchronized.

HARPER Reports to Industry on Heat Processing

Vigorous competition in every field demands engineering that anticipates as well as meets industrial requirements heretofore undreamed of! Your inquiry about Harper Electric Furnaces will be welcomed as a challenge to come up with helpful answers for you,—write today!

HARPER ELECTRIC FURNACE CORP.
51 River St. Buffalo 2, N. Y.
Furnace Builders for Over 35 Years
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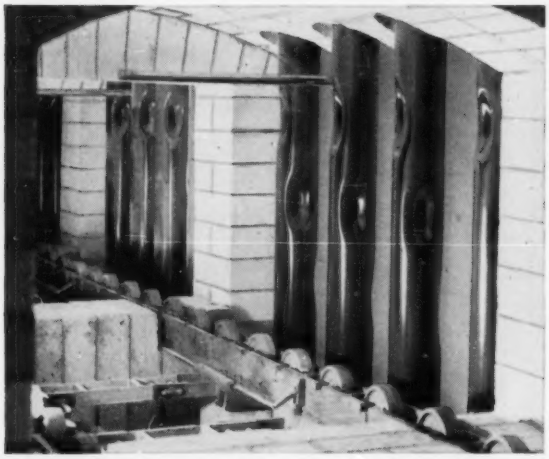
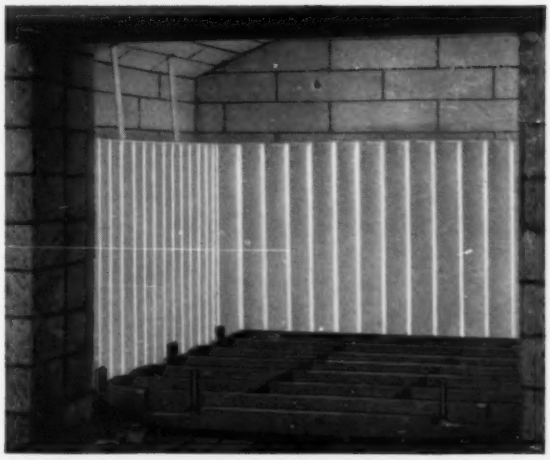
For further information circle No. 22

Whatever your source of heat...

LINDBERG HEAT TREATING FURNACES OFFER THESE EXCLUSIVE ADVANTAGES





. . . IN THE GAS-FIRED FURNACE

NEW LINDBERG VERTICAL RADIANT TUBE

Because of its revolutionary design, this tube provides a new level of gas-fired furnace performance. The secret lies in the new Lindberg tube's "dimples." The tube carries a central stream of mixed air-and-gas surrounded by a cylindrical stream of air alone. Combustion occurs in the area between these two streams. The "dimples" create eddies accelerating combustion and maintaining even temperatures along the entire tube.

This Lindberg tube will operate at maximum efficiency for a longer period of time. The special protective coating gives greatest possible resistance to carbon penetration. Vertical position eliminates soot deposit and resultant temperature increases at points of sooting.

Tubes are 59 inches long, weigh only 29 pounds, changeable in a few minutes. No costly furnace shutdowns nor high labor and material cost for tube changes.

. . . IN THE ELECTRIC FURNACE

NEW LINDBERG CORRTHERM ELEMENT

CORRTHERM, Lindberg's radically advanced new electric heating element offers advantages never before available for heat treating furnaces. With this new element carburizing and carbonitriding with electricity becomes practical, efficient and economical. Ideal, too, in other types of Lindberg electric furnaces.

The outstanding feature of the CORRTHERM element is the extremely low voltage at which it operates. Consequently, leakage through carbon saturation and shock or short hazards are eliminated. Elements also act as baffles to direct circulation of convection streams.

CORRTHERM elements are practically indestructible. Work load or operator's charging tool can't hurt them. Watts density is at all time low. Easily installed or replaced, too, as element merely hangs in furnace and no complicated mountings are required.

Lindberg Field representatives in 21 cities are ready to show you how Lindberg furnaces with these revolutionary new elements can improve your heat treating process. You'll find your Lindberg representative's name in the classified section of the phone book or write us direct.

LINDBERG FURNACES

LINDBERG ENGINEERING COMPANY

2466 W. Hubbard Street • Chicago 12, Illinois

For further information circle No. 23

EFFICIENT FURNACE OPERATION

(*Continued from page 11*)

Table I

Natural Gas Combustion

Fuel Constituents	Mixture before Combustion: Cu. ft. of gas	Mixture before Combustion: O_2 Required	Mixture before Combustion: Air (dry) Required	Cu. ft. of Products of Comb.: H_2O	Cu. ft. of Products of Comb.: CO_2	Cu. ft. of Products of Comb.: N_2	Cu. ft. of Products of Comb.: Total	Gross BTU
CH_4	.83	1.66	7.94	1.66	.83	6.28	8.77	841
C_2H_6	.14	.49	2.34	.42	.28	1.85	2.55	251
N_2	.02	—	—	—	—	.02	.02	—
H_2O	.01	—	—	.01	—	—	—	—
	1.00	2.15	10.28	2.09	1.11	8.15	11.35	1092

Theoretical Air Requirement = 10.28 cu. ft.

Total Combustion Products = 11.35 cu. ft.

Total Combustion Products (dry) = 11.35 — 2.09 = 9.26 cu. ft.

Ultimate CO_2 = $\frac{1.11}{9.26} \times 100 = 12\%$

Heat Content = 1092BTU

Chart (1) shows the volume relationship of these gases (as seen in Table I) to air over the range of air deficiency and excess air. The gas volumes are on a dry volume basis since water vapor is trapped out ahead of gas analysis equipment.

The waste heat carried out of the furnace in the exit gases bears a relation to their air content. Therefore one of the more important functions of the gas analyzer is to control air at low values. Waste heat is at a minimum and maximum combustion efficiency is obtained when excess air is maintained at the lowest value (optimum excess air) that allows complete combustion of the fuel. Optimum excess air depends upon many variables of the fuel, the burning equipment and the furnace. For the natural gas fuel of Chart (1) it is assumed to be 5% excess air (.05x10.28 =5.14 cu. ft. of excess per cu. ft. of natural gas). This low value is possible only in highly efficient gas burner and furnace designs.

(*Continued on page 30*)

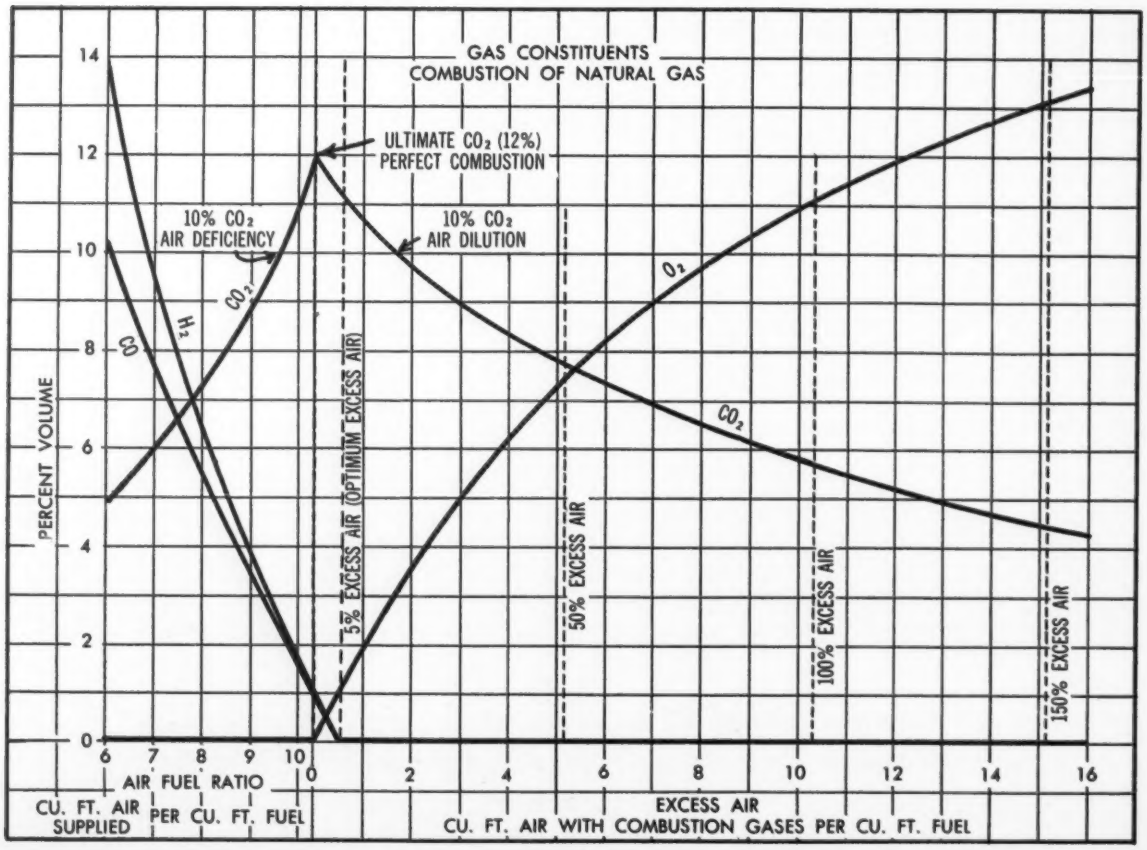


CHART 1.

QUENCHING... the tail that wags the dog

Steel analysis can be perfect, temperatures "right on the nose", atmospheres ideal—but it's the *quench*—the tail end of the heat treating process that makes the rest of the operation pay off.

And when that quench is oil, don't take chances—use Houghto-Quench.

- It provides complete "wet-out"—no soft spots, less carry-off.
- It provides maximum stability—doesn't "thicken-up", rarely has to be changed.
- It gives you the speed you need—other oils can't touch the quenching speed of Houghto-Quench, and it's this speed that assures adequate hardness even for steels in the low hardenability range and heavy sections.

It doesn't pay to take chances with ordinary, inferior quenching oils! Ask your Houghton Man to show you the superior performance of Houghto-Quench. Or, write for "Quenching" folder. E. F. Houghton & Co., 303 West Lehigh Avenue, Phila.33, Pa.

QUENCHING OILS

. . . products of

E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

For further information circle No. 24

(*Continued from page* 28)

Either a CO_2 or an O_2 analysis may be used to evaluate excess air and to judge the efficiency of combustion. The ultimate CO_2 figure, for example, corresponds to zero in excess air, the ideal objective of perfect combustion. Thus an 11% CO_2 reading is known to be an excellent operating point for natural gas, since it is but 1% short of the ideal objective of 12%, the ultimate CO_2 value. Similarly a 1% O_2 reading denotes high efficiency since it is only 1% short of perfect combustion, 0% O_2. The oxygen analysis, however, offers greater accuracy and ease of interpretation particularly where mixed fuels are burned or where the source of the fuel and its chemical composition may vary. This is true since the O_2—excess air curves converge at zero for all fuels and the ideal objective is thereby fixed at zero oxygen regardless of fuel type or composition. This contrasts with the variation in ultimate CO_2 values for different fuel types and fuel analyses; coke oven gas approximates 10.5%, natural gas 12%, propane 14%, oils from 15 to 17% and coals from 16 to better than 20%.

An O_2 analysis is always a positive indication of excess air. This is not necessarily true for a CO_2 analysis. In Chart (1) it will be noted that a 10% CO_2 reading obtained with a deficiency of air could very well be misinterpreted for excess air. Again in metallurgical furnaces, glass tanks, cement kilns and many chemical processes where process gases dilute the combustion products, excess air conditions can be evaluated only by an oxygen measurement. Other indirect methods of analysis are in error to the extent these diluent gases are present.

An oxygen measurement alone, however, is not necessarily indicative of good combustion practice. At low excess air values it is reasonable to expect the presence of H_2 and CO in the combustion products. Only an additional analysis for these gases can pinpoint where incomplete combustion ceases and maximum combustion efficiency is obtained. The combination, then, of an oxygen and combustible gas measurement as provided by the Heat Prover is the essential, scientifically accurate information which when intelligently used will lead to improved efficiences.

Fuel Savings

The Heat Prover oxygen readings may be readily interpreted in terms of the equivalent CO_2 or excess air values, and fuel savings may be estimated by referring the Heat Prover data to fuel combustion charts. A typical set of curves for natural gas is plotted on Chart (2).

(*Continued on page* 34)

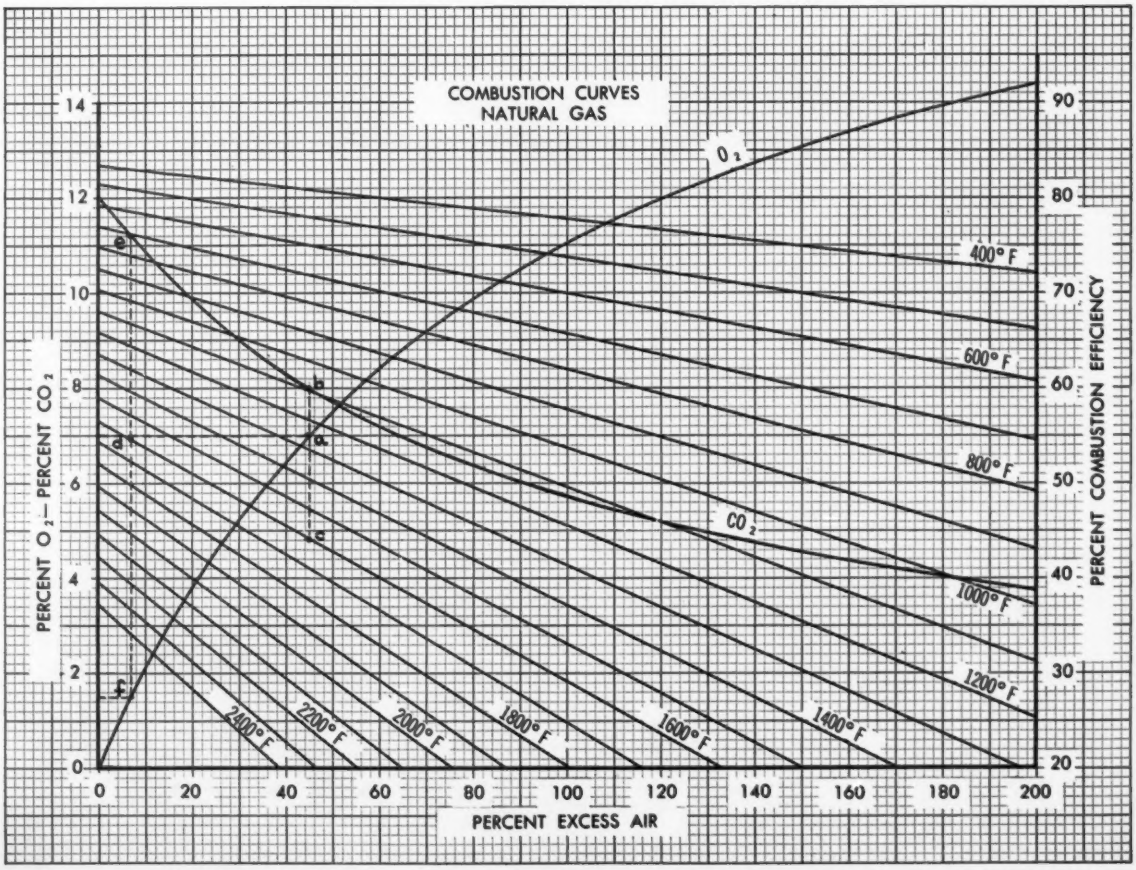


CHART 2.

Carbonitriding with Armour Ammonia

is cleaner, safer, more economical than carburizing or liquid cyaniding!

CLIP AND MAIL THIS TODAY!

Reduces distortion, imparts resistance to rusting and corrosion, produces cases of outstanding uniformity!

Carbonitriding results in a minimum of distortion because it permits lower operating temperatures and less severe quenching. The increased hardness it produces offers greater resistance to rusting and corrosion, and often permits substitution of plain carbon for alloy steels.

Carbonitriding is readily adaptable to mass production methods. Lower operating temperatures reduce furnace maintenance costs. Simplified washing and cleaning operations make working conditions cleaner and safer.

Our Technical Service Department is equipped to handle and answer any problems arising with ammonia installations for metal treating. Send today for free booklets offered at right. If your problems are unusual or pressing, write, giving full details.

Save money on our tank truck delivery service!

Please send me free booklets which I have checked:

- ☐ "Ammonia Cylinder Installations for Metal Treating"
- ☐ "The Role of Water Vapor and Ammonia in Case Hardening Atmospheres"
- ☐ "Case Hardening of Steel by Nitriding"
- ☐ "A Survey of Industrial Carbonitriding Practice"
- ☐ "Investigation into the Carbonitriding of Plain Carbon Steel"
- ☐ "The Carbonitriding of Alloy Steels"
- ☐ Tank truck service information

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Firm_____

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ARMOUR *Ammonia Division*

Armour and Company • 1355 West 31st Street • Chicago 9, Ill.

For further information circle No. 25

Just Published!

The NEW AMERICAN MACHINIST'S HANDBOOK

Edited by RUPERT LE GRAND

Senior Associate Editor, *American Machinist*

Based upon earlier editions of
AMERICAN MACHINISTS' HANDBOOK
edited by Fred H. Colvin and Frank A. Stanley

1579 pp., 5⅜ x 8, 774 illus., $11.00

BIGGEST IMPROVEMENT IN NEARLY 50 YEARS!

80% rewritten
Rearranged to give more facts—easier reference.
Fully up-to-date
1579 pages
774 illustrations
45 big sections

Here's the biggest news in years for machinists, toolmakers, apprentices, designers, engineers, inspectors—in fact *all* in the metal working industry. Now you can have the on-the-job help of an *amazingly improved, fully up-to-date,* NEW AMERICAN MACHINIST'S HANDBOOK.

Long a highly-regarded working tool, this book now has been completely revised and modernized in every way to make it a 1955 practical companion for technical men. Whether it's in design and drafting—machining and forming methods—metal finishing—or other major phases of your work—your problem can be better answered, solved more quickly, easily, and dependably with the aid of the wealth of modern descriptions, practices, and data given in this book.

The facts behind this monumental change

Think of the advances of recent years of metalworking in all its aspects—not only the normal development of better tools and techniques in an important industry, but also the further advances demanded by work on new materials and new design applications! *The growth in metalworking technology, standards, and practice has been tremendous*—faces every man in the field with a great need for new working information. To meet this urgent need, the NEW AMERICAN MACHINIST'S HANDBOOK has been created—fully abreast of today's practice—and given to you with the practical treatment and handy reference features that will make this the "bible" of the industry for many years.

Gives day-to-day help in your work

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271 NORTH AVE.
NEW ROCHELLE, N. Y.

For further information circle No. 26

NEWS TO HEAT TREATERS

(*Continued from page* 20)

Dow Doubles Production Facilities

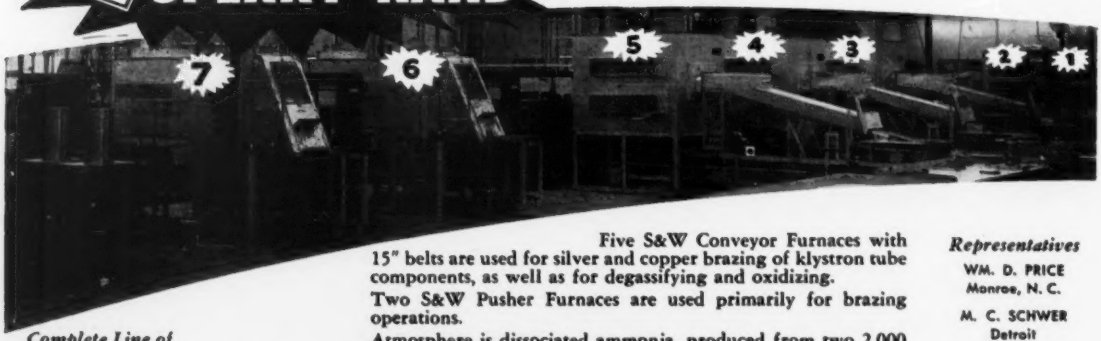
The Dow Furnace Company, Detroit 39, Michigan – pioneer manufacturer of mechanized batch-type controlled atmosphere furnaces—announce the completion of a building program which has

doubled their production area.

The additional room and the installation of a completely new automatic overhead handling system has enabled Dow to reduce delivery time, speed up spare parts handling and increase warehouse facilities.

7 Furnaces at SPERRY RAND

In the Sperry Electronic Tube Division of SPERRY RAND, Gainesville, Florida, a battery of 7 Sargeant & Wilbur furnaces perform faithfully and economically, aiding in the production of klystron tubes.



Five S&W Conveyor Furnaces with 15" belts are used for silver and copper brazing of klystron tube components, as well as for degassifying and oxidizing.

Two S&W Pusher Furnaces are used primarily for brazing operations.

Atmosphere is dissociated ammonia, produced from two 2,000 CFH S&W Ammonia Dissociators.

Purging atmosphere is supplied by a 1500 CFH Forming Gas Generator. This atmosphere is dried by an automatic, activated alumina dryer.

Write today for literature—and state your problem. Our staff of engineers is ready to advise without obligation.

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Complete Line of Electric and Fuel Fired Heat Treating Equipment • Furnaces • Generators Ammonia Dissociators Gas Conditioning Equipment Accessories

S&W **SARGEANT & WILBUR, INC.** 185 Weeden St., Pawtucket, R. I.

For further information circle No. 27

Ajax Electric Sales Manager

Mr. Edward N. Case has been appointed Sales Manager of the Ajax Electric Company, salt bath furnace manufacturers. Mr. L. B. Rosseau, Vice President of Ajax Electric, announced that Mr. Case will be in charge of all field sales activities from the Philadelphia office.

Mr. Case comes to Ajax from the American Cyanamid Company where he spent 12 years, the last few as Manager of the Metal Chemicals Section. His experience covers the metalworking field including laboratory work, technical service, direct selling, sales promotion, and management. He has been granted several patents, contributed articles to such publications as *Metal Treating*, *Journal of Metals*, *Metal Progress*, and *Steel*, and has been in demand as a lecturer before various technical societies.

Conveyor Belt Plant

Ashworth Bros., Inc., has just announced the completion of a new $500,000 conveyor belt plant in Winchester, Virginia. The new plant is designed for the continuous flow production of woven wire belts and flat wire belts ranging from belts one inch wide used in electronic ovens up to huge eighteen foot wide belts used in veneer drying. Ashworth belts have a wide variety of applications—used principally in the glass, ceramic, food processing, heat treating, chemical, material handling, and processing industries.

Mr. Frederick W. Hale, General Manager, said that the new plant is ideally situated for shipping facilities and is near the most concentrated industrial area in the United States. Mr. Hale also said that the present Worcester Mas-

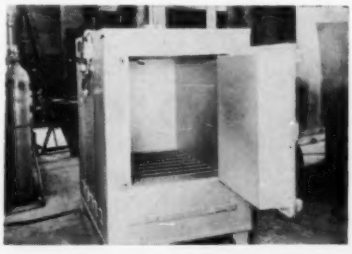
sachusetts plant will continue to operate with improved service and delivery to the northeast section of the country.

For further information circle No. 28

New Gas-Fired Oven

This oven was especially designed and built to meet the needs of industry for operations that require an oven with adjustable temperature control from 100°F to 1000°F.

Construction is all steel—a cabinet within a cabinet—with 5" of Rockwool insulation. Gas burners at the bottom of the oven supply the heat. A heavy-duty grate is



built-in over the heating system (not shown in photo). Partlow temperature controller included as standard equipment. A particular feature of this oven is its drip pan which is removable from the oven exterior and may be taken out for cleaning while the oven is in operation. The oven can be built for heating electrically. Size of work space is 26" x 30" x 30" deep.

For further information circle No. 29

(Continued on page 35)

How to choose and use materials

HANDBOOK OF ENGINEERING MATERIALS

Prepared by a Staff of 52 Specialists
Edited by Douglas F. Miner, Carnegie Institute of Technology, and John B. Seastone, Olin Mathieson Chemical Corporation.

Broader in scope than any other work of its kind

Unlike the conventional handbook, the coverage of this comprehensive volume is not limited to any single field. It provides a single source of authentic reliable information on the materials of manufacturing and construction in *all* branches of engineering.

It is of particular value to the specialist working in an area where several fields overlap—and ideal for the engineer or student facing materials problems involving areas of knowledge outside his own field.

Its arrangement makes easy the ready comparison of competitive substances and also serves as an index of alternative materials where the preferred material may not be available. Compact and easy to use, it covers all the main factors involved in the selection of a material—properties, fabricating qualities, availability, and costs—and provides references for information on an almost inexhaustible range of substances.

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1382 pages
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Semi-Flexible Binding
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METAL TREATING

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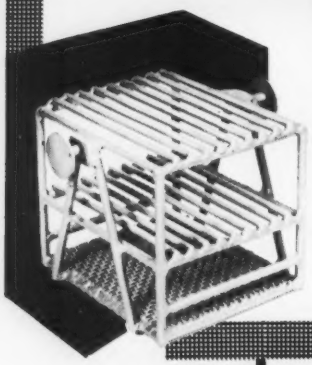
For further information circle No. 30

An Example of **Wiretex Ingenuity**



After 4 months of 24 hour-a-day, 5 days-a-week use, customer found no signs of warping or corrosion. Neither extreme high temperatures nor long hours in the carburizing, molten salt bath, quenching or cleaning applications had any adverse effects.

Call Wiretex

for all your heat treating requirements—to resist acid, heat, abrasion or exposure. Every weave, metal or alloy. Ask for Literature.

Better Design Permits

- Easier loading and unloading.
- Maximum number of parts in a minimum space.
- Largest possible surface area of each part exposed.
- Perfect draining and cleaning.

Wiretex mfg. co. 16 Mason St.
Bridgeport 5, Conn.

Specialists in Processing Carriers Since 1932

For further information circle No. 31

Welding Rod RA 330-80
FOR ARC WELDING RA 330
35% Ni - 15% Cr - 1¼% Si
HEAT RESISTING ALLOY

Especially developed for use on the high silicon 35% Nickel—15% Chromium RA 330 heat resisting alloy

CRACK-FREE weld deposits without preheat or post-heat

GOOD ARCING and handling characteristics

WELD DEPOSITS free of porosity and slag inclusions

Suitable for welding both cast and wrought alloy. Write or ask for additional information on the RA330-80 electrode.

When you next fabricate a fixture or furnace part, try the new, improved team of RA 330 alloy and RA 330-80 arc rod.

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RA 330	35% Ni–15% Cr–1¼% Si	RA 310	25% Cr–20% Ni
RA 309	25% Cr–12% Ni	RA 430	17% Cr
		RA 446	27% Cr

Rolled Alloys, Inc.
Heat and Corrosion Resistant Alloy Specialists
4815 BELLEVUE AVENUE, DETROIT 7, MICHIGAN TEL. WALNUT 1-4462

For further information circle No. 32

EFFICIENT FURNACE OPERATION

(Continued from page 30)

Example

Consider a radiant tube heat treating furnace, fired with natural gas. A Heat Prover analysis at a burner stack indicates an oxygen content of 7%, 0% combustible and an exit gas temperature of 1600°F.

Chart (2) indicates—

1. Combustion was performed with 45% excess air (point "a")
2. Dry sample of combustion products contains 8% CO_2 (point "b")
3. Combustion efficiency is 44% (point "c")—44% of the total heat of the fuel is released within the furnace, the remaining 56% is carried out the stack in the exit gases.

The burner controls are now adjusted to reduce excess air and thereby increase the combustion efficiency. At a 1% oxygen value, the Heat Prover combustible meter moves off zero indicating insufficient air is being supplied. To insure complete combustion of the fuel, controls are set finally at 1.5% oxygen.

Referring to Chart (2) the excess air is now 7% (point "d") and the equivalent CO_2 is 11.2% (point "e"). The combustion efficiency at an exit gas temperature of 1600°F. is now 54.7% (point "f"), an increase of 10.3%. The fuel savings realized by adjustment of the controls is:

$$\frac{54.7-44}{54.7} \times 100 = 19.6\%$$

High combustion efficiency also leads to decreased furnace heating times and increased furnace production rates. These economies can often be evaluated only by examination and study of the furnace plant production records.

In industrial furnace processes where the combustion gases are in contact with the work, high combustion efficiency is often sacrificed to obtain the exact oxidizing or reducing conditions demanded by the process. In such cases the Heat Prover readings themselves indicate the extent to which the furnace atmosphere is oxidizing or reducing. With the aid of the instrument it is possible to explore in detail any part of the furnace atmosphere.

Again in many controlled atmosphere furnaces, with inert or lean exothermic gas mixtures, the Heat Prover is useful for control purposes and for trouble shooting the atmosphere quality at the generator and in the furnace.

Various Applications

The industrial combustion processes in which the instrument has been successfully applied are numerous. Some of the more important industrial applications are:

1. *Steel Furnaces*—The Heat Prover provides an analysis of open hearth furnace gases which is technically accurate—independent of variations

in fuel composition and unaffected by gases from the charge. The instrument is also used on blast furnaces, soaking pits and reheating and heating furnaces.

2. *Glass Tanks*—Production rates and product quality are benefited by precise control of burner combustion at low excess air values.

3. *Industrial Furnaces*—One of the larger fields of Heat Prover use is on the many and varied heating and heat treating furnaces found in the metals and metals processing industries. The instrument provides a practical and accurate method for bringing furnaces into efficient combustion alinement and for studying the furnace atmospheres.

4. *Cement Kilns*—As in steel and glass furnaces, a direct analysis for oxygen is necessary to correctly evaluate excess air in the waste gases.

5. *Ceramic and Refractory Kilns*—The Heat Prover provides a convenient method for bringing the individual burners into proper combustion alinement.

6. *Steam Boilers*—It is widely used for checking the accuracy of CO_2 recording equipment. Additional useful information is obtained by sampling in the various passes to locate areas of air infiltration and the presence of secondary combustion.

7. *Internal Combustion Engines*—The combustion analysis of the Heat Prover is a guide to improved engine design, better engine performance and fuel economy. It has been widely used for diesel and gas engines.

The scope of Heat Prover activity extends to core oven, coke oven and cupola operations. The instrument is also finding increased use in the study of protecting gas atmospheres and in the control of chemical oxidation processes.

■ ■ ■

NEWS TO HEAT TREATERS

(Continued from page 33)

Chilling Unit

A new, low-temperature chilling unit with an exceptionally large thermal capacity, has been developed by Cincinnati Sub-Zero Products, Cincinnati, Ohio. Designed especially for quenching procedures in the heat treating of perishable tools, the new machine is also suitable for many other types of low temperature work.

The unit is capable of chilling 250 pounds of tool steel from +80°F. to −120°F. per hour. The chilling chamber is 48" long, 18" wide, and 33" deep. It is made of electric-welded pressure tight galvanized steel. Total chamber capacity is 16 cu. ft. or 110 gallons.

The machine is used in heat treating of alloy steels where low temperature quenching is required to achieve transformation of austenite to martensite. This low temperature is also used for normalizing and stress relieving of non-ferrous castings, and chilling for expansion-fit assembly.

It is equipped with two counterbalanced lids, which remain open in any position. Instrumentation

The metal spars used in rotor blades of the famed Piasecki "workhorse" must stand great stress and strain.

For strength and flexibility...

20′ PIASECKI ROTOR SPARS QUENCHED IN SUN QUENCHING OIL LIGHT

At the Metlab Company of Philadelphia, Sun Quenching Oil Light plays a major role in the successful quenching of the 20 ft Piasecki spars.

Sun Quenching Oil Light helps give the spars exactly the qualities they need... maximum strength with a minimum of distortion. *Proof once more of the ability of Sun Quenching Oil Light to perform difficult oil quench jobs, satisfactorily.*

For more information about Sun Quenching Oil Light, see your Sun representative or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. MR-11.

To heat treat the Piasecki spars, Metlab Co. of Phila. uses unusual techniques... and...Sun Quenching Oil Light.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY SUNOCO

PHILADELPHIA 3, PA.

IN CANADA: SUN OIL COMPANY LTD., TORONTO AND MONTREAL

For further information circle No. 33

and controls include a temperature controller, with a range from −70° to −150°F., a recording thermometer with range from 0° to −150°F., and 12″ 24-hour chart. Two 5 HP ball bearing motors power the refrigeration system. Construction is of heavy gauge steel. Overall dimensions, exclusive of externally-mounted agitator are: 96″ long, 50″ wide, 45″ high.

For further information circle No. 34

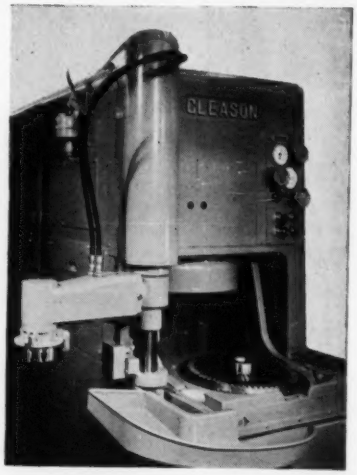
Quenching Press

A completely automatic unloader for the Gleason No. 16 Quenching Press is now available.

The unloader attaches to the left front corner of the press, (see cut) and is controlled by built-in switches and valves. It can be attached to existing No. 16 Quenching Presses.

Sequence of operation of the unloader is as follows:

1. As the press carriage advances to unloading position, the unloader arm rotates into position over the quenched part.
2. The unloader head lowers, and adjustable jaws close on the quenched part.
3. Holding the quenched part, the unloader head raises and rotates through 180 degrees.
4. The jaws open, releasing the quenched part into a tote basket or a conveyor.



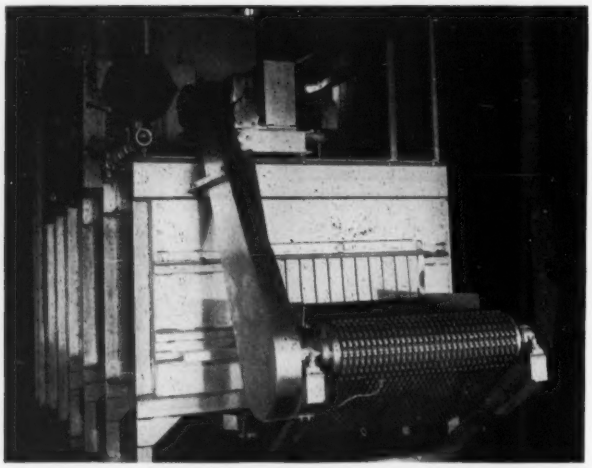
The Gleason No. 16 Quenching Press accommodates round, flat, or irregularly-shaped parts up to 15″ in the largest dimension. The press provides quenching under close automatic control at all stages of the quenching cycle. Since the parts are held between accurate dies during the quenching cycle, they are properly hardened with a minimum of distortion.

For further information circle No. 36

Miniature Telemeter Receivers

Miniaturized Metameter Telemeter receivers, which can be used in graphic panel arrangements, have just been announced by The Bristol Company of Waterbury, Conn. These receivers are available either as indicators or strip-chart recorders, and occupy a panel space only 5 inches square.

Designed to fit into the company's Metagraphic instrument line, the indicators and recorders can be used to receive telemetered



HEAT BOTH THIN AND THICK SECTIONS EVENLY

"Circ-Air" Furnaces bring parts having both thin and thick sections to heat evenly and rapidly.

The Continuous "Circ-Air" Furnace illustrated processes 1000 pounds per hour. Various sized steel parts are heated to 1250 degrees F. in 30 minutes. These parts are held at heat one hour for drawing. Fuel consumption is 800 C.F.H. of 1000 BTU gas.

See why "Cir-Air" furnaces heat speedily and precisely.

Send for our Bulletin 13-A.

"CIRC-AIR"

INDUSTRIAL HEATING EQUIPMENT COMPANY

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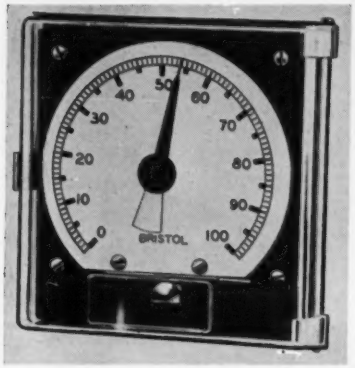
DETROIT 7, MICHIGAN

For further information circle No. 35

signals of any of the usual variables, such as pressure, flow, temperature, differential pressure, and such electrical measurements as voltage, current, and power. They



are identical in appearance to the standard Bristol Metagraphic pneumatic transmission instruments for short distance transmission of measurements, and thus provide for uniform appearance in a graphic panel presentation, as well as in conventional instrument panel arrangements.

For further information circle No. 37

NEW HEAT TREATING COMPANY

Mr. William E. Litterer has announced the opening of the Acme Heat Treating Company in Philadelphia, Pennsylvania. Mr. Litterer is President of the new company and Mr. Ralph Pellegrino is Vice President. Mr. Pellegrino was formerly Sales Manager of Arjay Machine Co. in Philadelphia.

From 1943 to 1947 Mr. Litterer owned the Ace Heat Treating Co. in Elizabeth, New Jersey; then became superintendent of heat treating at the Philadelphia Gear Works; and then plant manager at Electric Steel Treating in Bordentown, New Jersey.

The new company specializes in heat treating of tools, dies and plastic molds.

this

HEVI DUTY

Nitriding Furnace

GIVES US WHAT WE WANT...

Paul C. Farren, Chief Metallurgist at Hartford Machine Screw Company, says, "I like this Hevi Duty Vertical Retort Nitriding Furnace because

1. We can nitride all types of steel including stainless.
2. This Hevi Duty Furnace is adaptable to the Floe process of Nitriding.
3. We get uniformity throughout the entire load.
4. The parts come out clean and treated to very close tolerances.
5. A large pay load with low ammonia and power consumption saves us money.
6. This furnace stands up under continuous use.
7. Control is easy, giving us exacting case depths in each heat and uniformity from heat to heat."

These and the many other advantages built into Hevi Duty Nitriding Furnaces can benefit you. Write for more information today — Bulletin HD-646-R.

HEVI DUTY ELECTRIC COMPANY

MILWAUKEE 1, WISCONSIN

Heat Treating Furnaces... Electric Exclusively

Dry Type Transformers *Constant Current Regulators*

For further information circle No. 38

INSTITUTE NEWS

1955 ANNUAL MEETING

The Annual Meeting of the Institute was held at the Hotel Warwick, Philadelphia, Pa., October 14 through October 16.

On Friday, October 14th, Mr. Harold J. Babcock, Chief Metallurgist of the Artillery Ammunition Division of Frankford Arsenal, delivered an address entitled "Heat Treatment of Steel Cartridge Cases." The talk was supplemented with a sound film.

Mr. C. Rex Bulley, representative of Lloyds of London, presented statistical data with reference to "The Present Status of the Metal Treating Institute Heat Treating Insurance Program."

On Saturday, October 15th, a premiere showing of the Westinghouse Electric Corporation's new show entitled "The New Age of Metallurgy" was held. The show consists of an oral presentation combined with a full color film-strip and sound film projected on a 21-foot vistarama screen. Speakers were: Mr. L. H. Gillette, Manager, Westinghouse Industrial Heating Sales; Mr. R. R. La Pelle, Manager, Westinghouse Furnace Sales; and Mr. E. C. Bishop, Engineering Section Manager, Westinghouse Materials Manufacturing Department.

At the business meeting held on Sunday, October 16th, the following officers were elected: President, H. N. Bosworth, Bosworth Steel Treating Company, Detroit, Michigan; Vice-President, K. U. Jenks, Lindberg Steel Treating Co., Inc., Melrose Park, Illinois; and Treasurer, L. G. Field, Greenman Steel Treating Co., Worcester, Massachusetts, was re-elected.

Four new members were elected to the Board of Trustees: C. G. Anderson, Anderson Steel Treating Co., Detroit, Michigan; Robert Davis, Perfection Tool & Metal Heat Treating Company, Chicago, Illinois; A. T. Ridinger, Metallurgical, Inc., Minneapolis, Minnesota and C. H. Knerr, Metlab Company, Philadelphia, Pa.

Two remaining Trustees whose terms did not expire this year are: A. E. Leidig, Hollywood Heat Treating Co., Los Angeles, California and Arthur Eklund, Jr., Eklund Metal Treating Inc., Loves Park, Illinois. Past President, C. M. Cook, Cook Heat Treating Co. of Texas, Houston, Texas, automatically becomes a member of the Board of Trustees.

Receiving his certificate of an Honorary Life Membership in the MTI is Mr. Fred Heinzelman, Sr. (left) of Fred Heinzelman & Sons, New York, from President Cook of the Metal Treating Innstitute.

Receiving the certificate for the Annual Achievement Award from President C. M. Cook are (l. to r.) Mr. E. H. Kinne, Assistant Supervisor, and Mr. L. L. McArthur, Chief Metallurgist of the Rollway Bearing Company, Inc., Syracuse, New York and President Cook of the Cook Heat Treating Company of Texas.

Award Presentation

One of the highlights of the Annual Meeting was the presentation of the Annual MTI Achievement Award. This year the award was presented to Mr. L. L. McArthur, Chief Metallurgist, and Mr. E. H. Kinne, Assistant Supervisor of the Rollway Bearing Company, Inc., Syracuse, New York for the joint authorship of their article which was published in the November-December 1954 issue of METAL TREATING, and was entitled "Dimensional Control System Minimizes Finishing Costs." (See cut).

Fred Heinzelman, Sr. Awarded Life Membership

President Cook also presented to Mr. Fred Heinzelman, Sr. of Fred Heinzelman & Sons of New York, a certificate of Honorary Life Membership in the Metal Treating Institute in recognition of his twenty-two

years of continuous membership and his many contributions to the MTI. (See cut).

Mr. Heinzelman is a descendant of a long line of Swiss blacksmiths and metal workers. He and his brothers worked not only in Switzerland, but also in Germany and France, learning the heat treating trade.

In 1908 he came to America, and in 1917 he established his company, Fred Heinzelman & Sons, in New York City. By so doing, he became the first commercial heat treater in the city.

In 1933 Mr. Heinzelman joined the MTI as one of the early members in the then newly-formed organization, and he has been very active in its affairs ever since. He and his four children are still running the company, and one of his sons, Fred Heinzelman, Jr., is a past President of the MTI, having served as President in 1949.

Allied Metal Acquisition

Allied Metal Treating Corp., main offices 830 South 5th Street, Milwaukee, announces the immediate acquisition of the complete facilities of the Bach Metal Treating Co., Port Washington, Wisconsin, founded January 1953.

This is the second acquisition acquired by Allied within recent months, the first being the Capital Heat Treating Co., Inc. of Racine since moved to Kenosha, Wisconsin.

The four processing plants now operating in Wisconsin as divisions of the Allied Metal Treating Corp., a Wisconsin chain, are presently located in Kenosha, Manitowoc, Racine, and the latest acquisition will henceforth be known in Port Washington as the Port Division of Allied Metal Treating Corp.

The officers of Allied, a Wisconsin corporation, chartered under Wisconsin laws, are:

President, Charles I. Wesley
Vice-President, Mrs. Ann F. Wesley
Secretary, Harold R. Wesley
Treasurer, Joseph F. Hushek
Gen. Sales Mgr., Joseph F. Wesley

HOWARD N. BOSWORTH
Newly-elected President of the Metal Treating Institute.

Charles I. Wesley started in the business of commercial steel treating on July 12, 1915 and is also president of the Wesley Steel Treating Co. formerly the Milwaukee Heat Treating Co., Milwaukee.

Adolph W. Machlet

Adolph W. Machlet, industrialist and inventor of more than sixty processes in the metallurgical field, died recently in his home at 1010 Lafayette Street, Elizabeth, New Jersey after a six-week illness. He was 90 years old.

Mr. Machlet was Chairman of the board of directors of the American Gas Furnace Company, manufacturers of gas-fired industrial furnaces, gas burners for industrial purposes and other products.

He was also president, treasurer and a director of its subsidiary, the American Metal Treatment Company. The latter which he was instrumental in establishing in 1907, does commercial heat treating, is a member of the MTI, and was organized chiefly to develop Mr. Machlet's inventions relating to that process.

Despite his age, Mr. Machlet continued to work on inventions in the last few years. He obtained his latest patent this year. He had come to his office, next door to his home, almost daily until his final illness.

Tempilstiks®
quick, simple, accurate way to tell temperatures

use like a crayon

to control working temperatures in:
- welding
- flame-cutting
- tempering
- forging
- casting
- molding
- drawing
- straightening
- heat-treating in general

$2 each
gives up to 2000 readings

It's this simple: mark the workpiece with the proper Tempilstik®. When the mark melts, the specified temperature has been reached.

Available in these temperatures (°F)

113	263	400	950	1500
125	275	450	1000	1550
138	288	500	1050	1600
150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
213	363	800	1350	1900
225	375	850	1400	1950
238	388	900	1450	2000

Also available in pellet or liquid form

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For further information circle No. 39

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

SKIN DISEASES

"Diseases of the skin are taking a far larger toll of the nation's industrial output, in terms of lost productive time and compensation payments, *than all other occupational diseases combined.* The cost to industry of the average industrial worker hit with a skin disease is: 10 weeks off the job; $100 in compensation payments; and $90 for medical care; totalling far more than $100 million annually."

These statements were made by Dr. Louis Schwartz, widely known industrial dermatologist and former Medical Director of the U. S. Public Health Service, at a press conference held to announce the publication of a new industrial guide booklet published by the Association of American Soap & Glycerine Producers, Inc., titled "THE PREVENTION OF OCCUPATIONAL SKIN DISEASES."

Stressing the vital need to safeguard industrial workers from actual or potential skin irritants in advance, the booklet presents a brief study of the anatomy and physiology of the skin, and lists causes of occupational skin diseases under five main headings:

1. *Mechanical* (friction, pressure, injury)
2. *Physical* (heat, cold radiation)
3. *Plant poisons* (several hundred woods and plants)
4. *Biological* (bacteria, fungi, mites, etc.)
5. *Chemical agents* — "primary irritants," such as strong acids or other corrosives; and "sensitizers" like TNT or resins that do not cause dermatitis at once but pave the way on further contact.

For further information circle No. 40

ANTI-RUST COATING OIL

The Sun Oil Company has just announced Sunkote A, a new anti-rust coating oil for improved low-cost protection of sheet and strip steel and ferrous castings. Sun's illustrated technical bulletin shows how Sunkote A works and how to apply it.

For further information circle No. 41

IMPROVED ALUMINUM BASE ALLOYS

Sand-cast 220 aluminum-base alloys, reported to have better mechanical properties than commercially available 220 alloy, have been produced by a process described in a report of Army-sponsored research just made available by the Office of Technical Services, U.S. Department of Commerce.

In studies conducted for Frankford Arsenal, Battelle Memorial Institute has developed a pro-

Editor's Note: This is the second cartoon in a new series. METAL TREATING will pay $10.00 for usable ideas for this cartoon series.

Sound Familiar?
CARELESS MILFORD IS NOT PARTICULAR ABOUT THE PARTS HE SENDS IN FOR HEAT TREATING
BOY!...TAKE A LOOK AT THIS CASTING!
...OFF SIZE, NICKED, CRACKED AND WHAT HAVE YOU. HOW DID IT EVER GET OUT OF THEIR PLANT,...OR DON'T THEY CARE?
Justrite Heat Treating Co.
BUT... WHEN HE GETS THEM BACK... WHAM! LOOK WHO GETS THE BLAME!!!
CALL YOURSELVES METAL TREATERS? HAH! YOU SURE GAVE OUR CASTINGS THE 'TREATMENT'! -THEY GO OUT OF HERE 100% PERFECT,...AND WHAT HAPPENS? DO YOU DROP 'EM OFF THE ROOF OR JUST RUN A TANK OVER THEM?..IF YOU HAVE NO CONSIDERATION FOR A CUSTOMER'S PRODUCT I'LL JUST HAVE TO...
HANK ROEHLER

cedure for producing and heat treating basic 220 composition in such a way as to minimize brittleness and other unfavorable characteristics of the alloy, while retaining its strength, ductility, corrosion resistance and machinability. Alloys were produced in the 220 alloy (Al-10Mg) range with 19 percent elongation, 27,000 psi yield strength and 53,000 psi ultimate strength. Alloys with reduced magnesium contents equalled or exceeded target specifications and showed increased strength and little change in ductility when aged at room temperature.

For further information circle No. 42

TEMPERATURE CONTROL CATALOG

The Burling Instrument Company of Chatham, New Jersey has issued a new condensed catalog covering their complete line of differential expansion temperature controls.

Included are pictures of all the current types, a description of their operation, general specifications of the entire line, and an Instrument Selection Chart.

The instruments shown are suitable either for controlling temperatures or for high temperature safety alarms and cut-outs. Both electric and pneumatic types are included, as are ranges from sub-zero to 1800°F.

For further information circle No. 43

HIGH-SPEED POTENTIOMETER

A bulletin describing the new High-Speed Recording Dynamaster Potentiometer has just been released by The Bristol Company of Waterbury, Conn. This recorder has a full-scale pen-travel across its 11-inch calibrated chart of only 0.4 second, without overshot on long or short traverses.

The two-color bulletin features a full-size reproduction of a sample chart which shows the dynamic characteristics of the new recording potentiometer.

For further information circle No. 44

MOLYBDENUM CHEMICAL SYMPOSIUM

The first comprehensive review of industrial applications of molybdenum chemicals has been published by the American Chemical Society and is now available in reprint form from Climax Molybdenum Company.

Comprising seven different papers, this survey details molybdenum's wide use in diverse chemical fields, and points to new industrial applications resulting from the present increased tempo of molybdenum research.

For further information circle No. 45

INSPECTION AS A PRODUCTION TOOL

A new 8-page booklet has been issued by the Magnaflux Corporation, Chicago, Illinois. It is the result of several years development work to describe amply a new idea —a new way of thinking—that is applicable to nearly every type of manufacturing activity.

It indicates how a nondestructive testing program can be instituted in the production departments, as a cost-reducing money-saving tool.

For further information circle No. 46

(Continued on page 44)

HEAT AND CORROSION RESISTANT
CASTINGS & FABRICATIONS
New LINDBERG TRAY and BASKET
This combination light-weight cast tray and wire mesh basket is designed for use with the Lindberg carbonitriding furnace. The Tray, weighing only 65 pounds, incorporates all the General Alloys features — such as cored intersections, full radii on all corners and edges, separate shoe arrangement, 60 Ni.-15 Cr. alloy — which provide maximum resistance to atmosphere and quenching. The Basket utilizes the inherent advantages of combination cast and fabricated alloy. It is made of wire mesh with a cast top ring, which minimizes distortion. Baskets can be supplied in varying heights and with varying sizes of wire, mesh openings and frames, to suit any load condition. Both tray and baskets can be delivered from stock.
GENERAL ALLOYS COMPANY
FABRICATED ALLOY DIVISION
403 WEST FIRST STREET • BOSTON 27, MASSACHUSETTS

For further information circle No. 47

LETTERS TO THE EDITOR

Gentlemen:

We recently received an interesting edition of your Metal Treating Magazine and would be interested in details on subscriptions.

ROBERT FRITZ
Purchasing Department
Simonds Saw and Steel Co.
Fitchburg, Mass.

Ed.—Eligibility form letter sent.

Dear Editor:

During my days at Surface Combustion in their advertising department, I became very well acquainted with your book, "Metal Treating" and found it of extreme value in the work over there.

In my new position here at Hugo Wagenseil Advertising Agency, I find many occasions in which I would be able to refer to Metal Treating magazine. For this reason I would appreciate your placing me on your mailing list if at all possible.

R. W. ELMENTHALER
Director
Technical-Industrial Promotion Bureau
Hugo Wagenseil Advertising Agency
Dayton, Ohio

Ed.—Have added the name, and glad to know the magazine is so helpful.

Dear Editor:

Congratulations on the Fifth Anniversary of "Metal Treating". Having seen the fumbling and stumbling in the starting of this magazine, it is certainly a pleasure to see the outstanding results achieved, as exemplified by the September-October issue.

Again, Congratulations. "Metal Treating" has arrived.

D. M. KNOCH
Metro Heat Treat Co.
Ridgefield, N. J.

Ed.—Thank you. That is a pleasant birthday greeting.

Gentlemen:

In reviewing article abstracts put out by the American Society for Metals, we noticed write-ups on the following articles which you have published. We are very much interested in these articles and, if possible, would appreciate your sending us tear sheets or copies for our technical file:

"The Sanford Process" by John B. Franklin, v. 5, Nov.—Dec. 1954, p. 2-3.

"Aluminum Coating Increases Oxidation and Corrosion Resistance of Steel", v. 5, Nov.—Dec. 1954, p. 11.

"Heat Treating Titanium" by Leo Schapiro, v. 6, Jan.—Feb. 1955, p. 20-21.

Thank you for your kind attention in this regard.

B. A. SCHWARTZ, JR.
Elechem Corporation
Cleveland, Ohio

Ed.—Copies of the magazine were sent.

For further information circle No. 48

It takes 65,000 gallons of water to produce one ton of finished steel, 5,000 gallons to grow a bushel of corn. Don't waste it.

'PSC' RADIANT TUBES in
Any Design or Dimension
Send for PSC Heat-Treat Catalog 54
PSC fabricated tubes furnish four substantial advantages: (1) Light-wall construction saves furnace time and fuel. (2) Return bends are of same wall thickness as tubes, promoting uniform flow of gas. (3) Smooth dense walls minimize carbon build-up and burn-out. (4) Up to 100% longer life. In any alloy, size or type, including parabolics. Also sheet-alloy heat-treating retorts and covers, boxes, baskets, fixtures, tubes, etc.
PSC
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For further information circle No. 49

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Pittsburgh 1, Pennsylvania

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SUN OIL COMPANY
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TOOL STEELS

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Bethlehem, Pennsylvania

CRUCIBLE STEEL COMPANY OF AMERICA
Pittsburgh, Pa.

MANUFACTURERS' LITERATURE

(*Continued from page 41*)

GRINDING WHEELS

"How to Select Grinding Wheels for Precision Grinding, Tool and Construction Steels" is the title of a booklet available from Norton Company, Worcester 6, Mass. This booklet consists of reprints of three articles that appeared in "Grits and Grinds," Norton's monthly magazine on better grinding. The articles were written by Clifton C. Nickerson, Norton grinding engineer. The booklet is liberally illustrated with photographs and charts.

For further information circle No. 50

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One car-type, oil-fired annealing furnace approx. 6' x 12' x 5'.

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For further information circle No. 51

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MT-12

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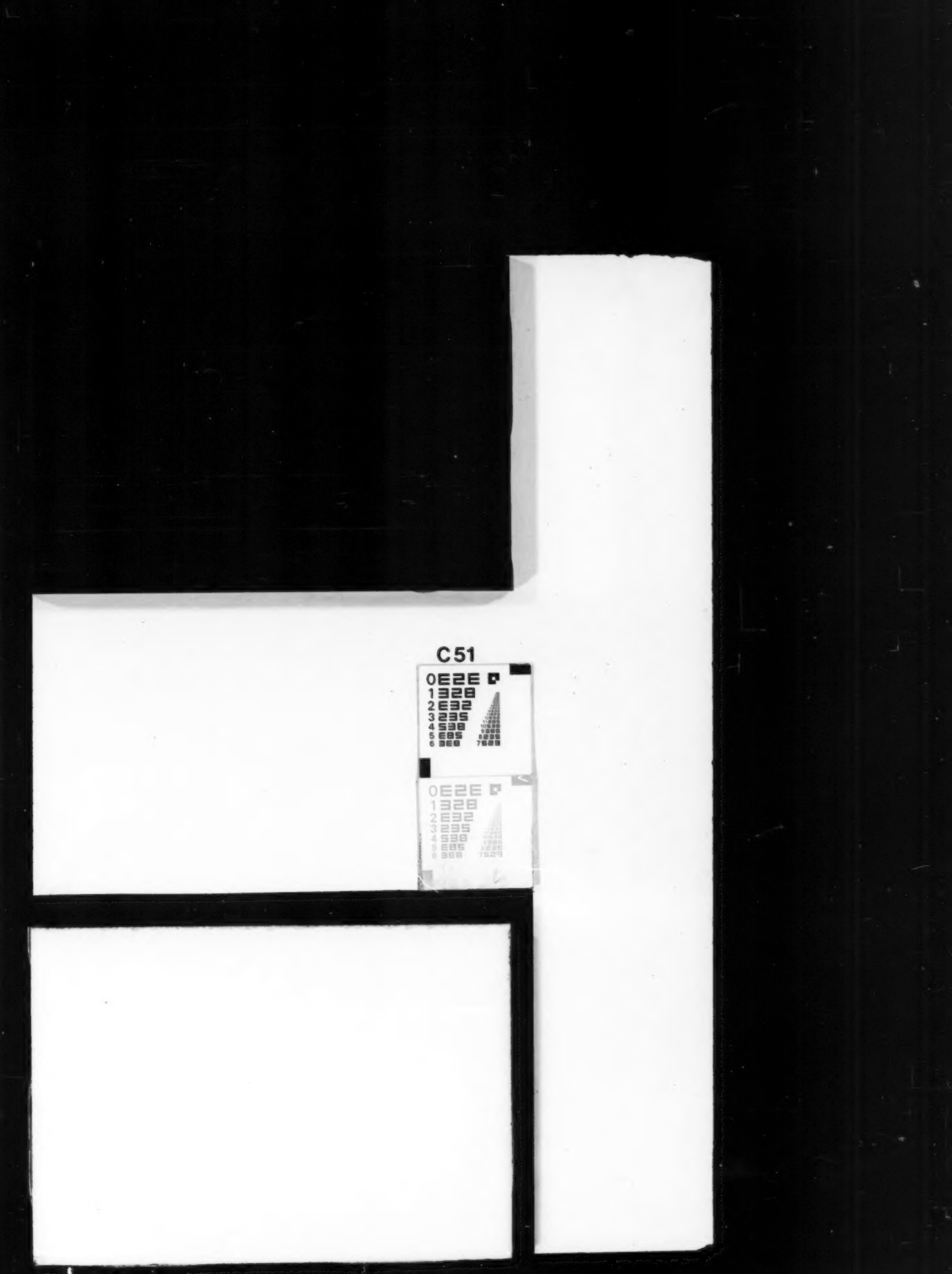
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